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Circuit Restoral Assessment Module

Computer Sciences Corporation
6565 Arlington Boulevard
Falls Church, Virginia 22046

7 September 1979

Topical Report for Period 7 November 1977—31 January 1979

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides software documentation of the Circuit Restoral Assessment Module (CRAM) developed by Computer Sciences Corporation. The report includes algorithm flow charts and descriptions, the data base build description and sample outputs.

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SECTION 1 - INTRODUCTION

This report describes the rationale, methodology and design of the Circuit Restoral Assessment Module (CRAM). The CRAM was developed in order to assess the recoverability of the European Defense Communications System (DCS). In previous studies it had been determined that the European DCS System Control capabilities were vulnerable to the nuclear and non-nuclear threat and that system connectivity was not optimized for recoverability. These studies were documented in a CSC report to DNA entitled, "Investigation of the Vulnerability/Survivability of Systems Supporting the NCA Decision Process," 2/76. A methodology for quantitatively assessing the recoverability of the DCS was subsequently developed and documented in another CSC report to DNA entitled, "Evaluation of Survivability/Recoverability Aspects of DCS System Control," 12/77. CSC then used this methodology as a basis for developing an automated analysis capability. The resulting tool was designated the CRAM.

The CRAM performs an automated analysis of the recoverability of the European Defense Communications System (DCS). The CRAM accomplishes this by simulating the response of the DCS technical control facilities and systems control elements to a major disruption in the DCS telecommunications network. Given a scenario in which nodes or links in the network have been destroyed or otherwise disrupted, the module identifies disrupted circuits, establishes reroutes for those circuits for which reroute paths exist, estimates circuit restoral times based on reroute path length, technical control work load, technical control orderwire availability and systems control effectiveness, and produces a report giving the status of the affected circuits, including the reason for disruption, the reason for non-restoral of those circuits which cannot be restored, and the estimated restoral time of those circuits which are restored. The CRAM is designed to be used as a stand alone module or as a component module of an Automated Assessment Tool (AAT) developed on the same DNA program.

The input to CRAM is a threat scenario which may include any number or combination of disrupted DCS communications links or nodes within the European Theater. CRAM recognizes two states in the operational status of a link or node, either operational or non-operational. CRAM accepts a single outage time and this time is used as the instant of degradation and the time at which restoral action begins. In the case of a scenario which extends over a period of time, an instant within the scenario time span must be selected as the disruption time and circuit restoral times are estimated as if all damage occurred at that instant of time.

Since the CRAM data base presently does not contain the Pacific Theater and CONUS, the first step in circuit restoral assessment is to check the location of the disrupted link or node to see if it is within the European Theater. If it isn't, this fact is noted, no restoral action is taken, and CRAM looks at the next disruption in the scenario. When a disrupted station or link in the European Theater is encountered, CRAM logs out all the subsidiary links, routes, trunks and circuits normally traversing the disrupted asset. In the process of doing this it also identifies those circuits which cannot be rerouted due to a disrupted end terminal. The purpose of doing this is to avoid searching for reroute paths for those circuits.

A route connectivity matrix is used for finding reroute paths. This matrix contains all the routes which can be used for rerouting purposes. Therefore, when one of these routes is disrupted it is no longer available for rerouting purposes. CRAM removes disrupted routes from this matrix.

CRAM establishes the existence or non-existence of orderwire connectivity between the end terminals of routes that are to be used for rerouting circuits. This is necessary in order to determine the coordination and patching times when estimating circuit restoral times. If an orderwire which directly connects the end terminals of a route exists and is operational, then coordination and patching time over that route is shorter than if direct orderwire connectivity does not exist.

Disrupted circuits and groups are sorted according to the end points of the disruption, or in other words, according to the two points around which a reroute is desired. This facilitates restoral time estimates and reduces the number of reroute path searches in the route connectivity matrix, thus reducing computer run time. In addition, where two or more adjacent routes are disrupted in a circuit path, the adjacent disruptions are concatenated and are treated as a single break in the circuit. This allows one reroute path to be established around multiple disruptions.

CRAM then finds reroute paths for the disrupted circuits. Because of the heavy channel fill in the DCS and the large number of priority-one circuits, in a crisis situation in which extensive system degradation is incurred, the only circuits that would be rerouted would be predominately, if not all, priority-one circuits. For this reason, and to simplify the restoral algorithm and reduce computer run time, CRAM restores only priority-one circuits.

The order in which circuits are restored and the manner in which reroute paths are established in a tech control facility are simulated by the CRAM restoral algorithm. That is, highest priority circuits are rerouted first. Reroute paths are established over the shortest, or most direct paths available. In general, technical controllers will reroute over spare channels if they are available, and they will readily preempt non priority-one circuits when spare channels are not available. It is further assumed that tech controllers will not preempt lower priority-one circuits with higher priority-one circuits until every effort has been made to locate spare channels or non priority-one circuits to preempt. All the above factors have been included in the restoral algorithm to realistically simulate technical control response to a crisis situation.

Having established reroute paths, CRAM then estimates circuit restoral times based upon reroute path length, tech control workload, orderwire availability and systems control effectiveness.

Factors affecting circuit restoral times which could not be taken into account such as tech control physical layout, insufficient patch cords and interbay trunks for extensive rerouting, technical controller proficiency, etc., will probably tend to make the restoral time estimates more optimistic than what would actually occur. Therefore, restoral time estimates made by CRAM should be considered best case estimates.

The first step in estimating restoral times is to determine ACOC effectiveness. Again, this is a best case estimate and assumes that the Area Communications Operations Center (ACOC) can fully assimilate all the data being received from the technical control reporting stations, assess the data, and respond quickly with guidance and direction to the affected technical control facilities. ACOC effectiveness is estimated by CRAM based on the availability of orderwires or other communications channels between the ACOC and the technical control facilities. These communications channels are the means by which system status is reported to the ACOC, and direction and guidance is provided by the ACOC. Without this means of communications, the ACOC would be fully ineffective. CRAM recognizes three states of effectiveness: non-effective, 50 percent effective and 100 percent effective.

CRAM takes into account reroute path length when estimating restoral times, reroute path length being the number of routes that must be interconnected with patch cords to establish the reroute path. The more patches required, the greater the coordination and patching time.

Coordination and patching time over a route is affected by orderwire availability between the end points of the route. If a direct orderwire is available between the end points, then coordination and patching time is a minimum. Where a direct orderwire does not exist, then coordination messages must be relayed through adjacent technical control facilities, over radio maintenance orderwires or via AUTODIN or AUTOVON. Thus, where direct orderwire availability does not exist, longer coordination time estimates are used.

Tech control work load is accounted for by using elapsed time logs which keep track of coordination and patching time over each route in which reroute activity is taking place. It is assumed that one tech controller is available to work each end of a route and that no more than one tech controller at each end of the route can effectively work that route. Thus, multiple reroutes being established over a particular route are worked sequentially and not simultaneously.

The CCSD records are updated to reflect the final status of each circuit and an output report is produced which shows which circuits were restored and their restoral times, and which circuits could not be restored and the reason for non-restoral.

Section 2 of this report, CRAM Algorithm, presents a detailed description, the algorithms and methodology of the CRAM. Section 3 provides a description of the CRAM data base design, and Section 4 provides examples of analysis of scenarios run on the CRAM.

SECTION 2 - CRAM ALGORITHM

The following paragraphs provide a detailed description of the CRAM algorithms and methodology. The description is organized around a series of flow charts which begins with a top level functional flow chart and then goes on to progressively more detailed flow charts. The subroutine flow chart identifiers are tabulated hierarchically for reference in Table 2-1.

Within the flow charts, abbreviated descriptions are provided within each symbol of the process performed. Where these processes are complex, reference is made to subroutines which perform the process. Also, associated with each flow chart symbol is an alphabetic character which facilitates cross reference to the descriptive text.

2.1 CRAM Executive Routine

Figure 2-1, CRAM Executive Routine, presents a top level view of the CRAM algorithm. In the following discussion, the alphabetic paragraph numbers correspond to the alphabetic characters on the flow chart associated with each flow chart symbol.

A The scenario is read.

B All the disrupted stations, links, routes, trunks, paths and circuits are identified. The outage time is entered in appropriate records. Also, routes or circuits are identified which are non-restorable due to disrupted end terminals. This avoids going through a reroute path search for non-restorable circuits.

C Orderwire connectivity is checked and orderwire restoral times are logged. Logging orderwire restoral time at this point is justified by the following assumptions.

1. An orderwire will logically be the first circuit restored on a route.
2. The reroute path will be one route long, as it will be restored directly on the route that it supports.

Table 2-1. CRAM Subroutines

1.0	Identify disruptions
1.1	Update Route Connectivity
1.1.1	Update Theater Connectivity Matrix
1.2	Set CCSD status
1.2.1	Log multipoint segments out
1.2.2	Log circuit out in ACOC Connectivity Matrix
2.0	Check orderwire connectivity
3.0	Sort circuits for rerouting
4.0	Reroute circuits
4.1	Path search
4.2	Preempt non-priority one circuits
4.3	Preempt spares
5.0	Estimate restoral times
5.1	Determine ACOC effectiveness
5.1.1	Check station work status
5.1.2	Determine station reporting status
5.1.3	Compute effectiveness
5.2	Assign restoral times
6.0	Update CCSD records
6.1	Log multipoint segments in.

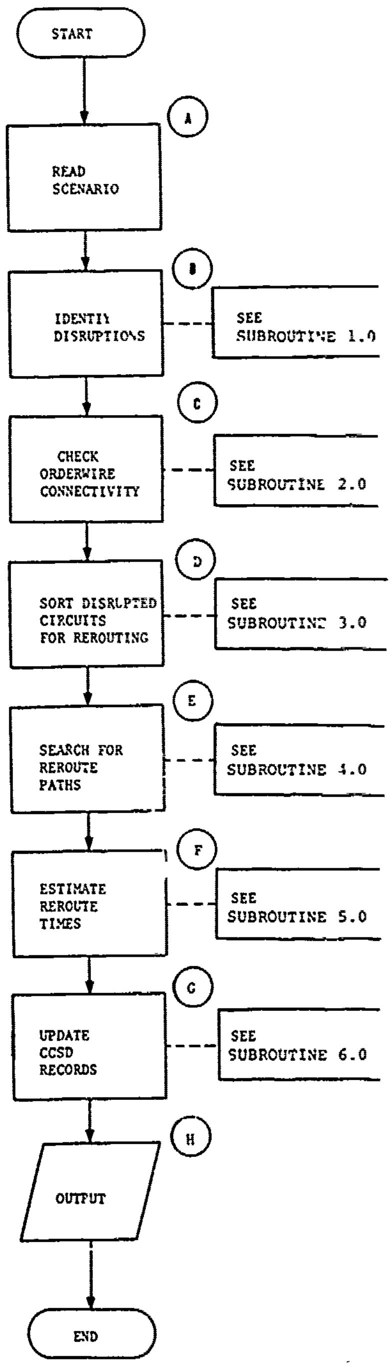


Figure 2-1. CRAM Executive Routine

3. Restoral time will be nine minutes - five minutes for local damage assessment and four minutes coordination and patching time.

By logging orderwire restoral times at this point, one avoids the problem of an iterative routine where restoral times are established for all the circuits, orderwire restoral times are determined, and then circuit restoral times are recomputed based on the new orderwire connectivity.

(D) This step groups all the circuits together that must be rerouted between any two particular points. This accomplishes two things. First, it reduces the total number of reroute path searches and second it facilitates circuit restoral time estimates since all the circuits on a particular reroute path will be listed together.

(E) Reroute paths are searched for.

(F) Restoral times on rerouted circuits are estimated.

(G) CCSD records are updated to include reroute action on circuits.

(H) Output reports are produced.

2.2 Subroutine 1.0 - Identify Disruptions

The following is a discription of Figure 2-2, Subroutine 1.0 - Identify Disruptions.

(A) Those stations which are not in the area of interest can be identified by the DCA area code and (B) the status set to 3. If they are in the area of interest, (C) the status will be set to 1, disrupted but restorable. The status code is needed in the restoral algorithm to indicate what reroute action is appropriate for a particular route or circuit. It can also be used in the output report to indicate why the circuit was not rerouted. The status codes are as

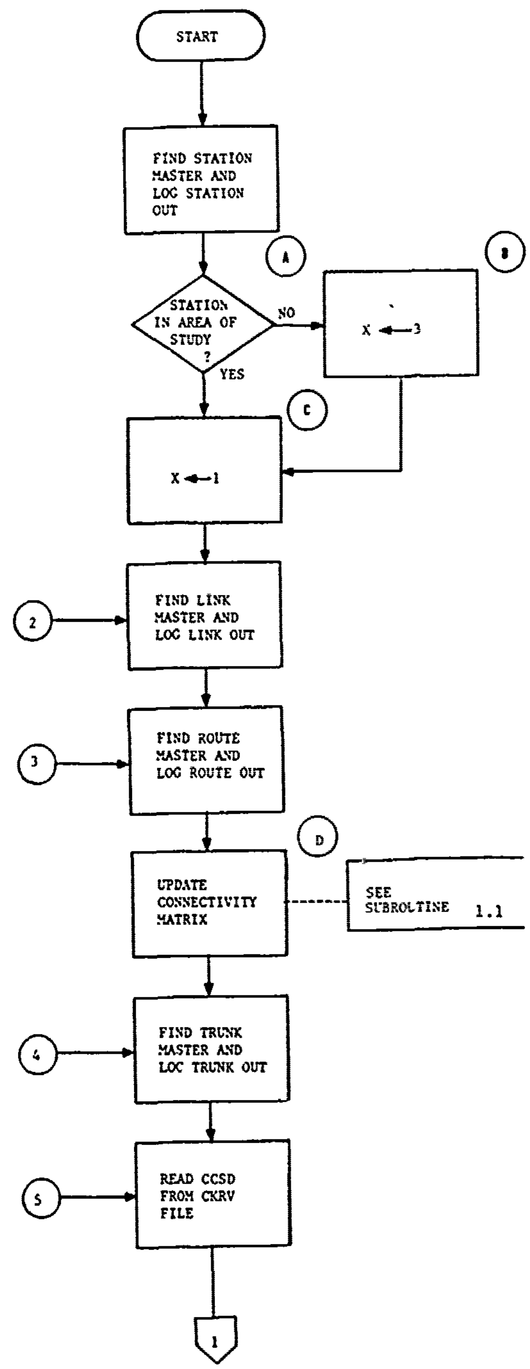


Figure 2-2. Subroutine 1.0 - Identify Disruption
(sheet 1 of 2)

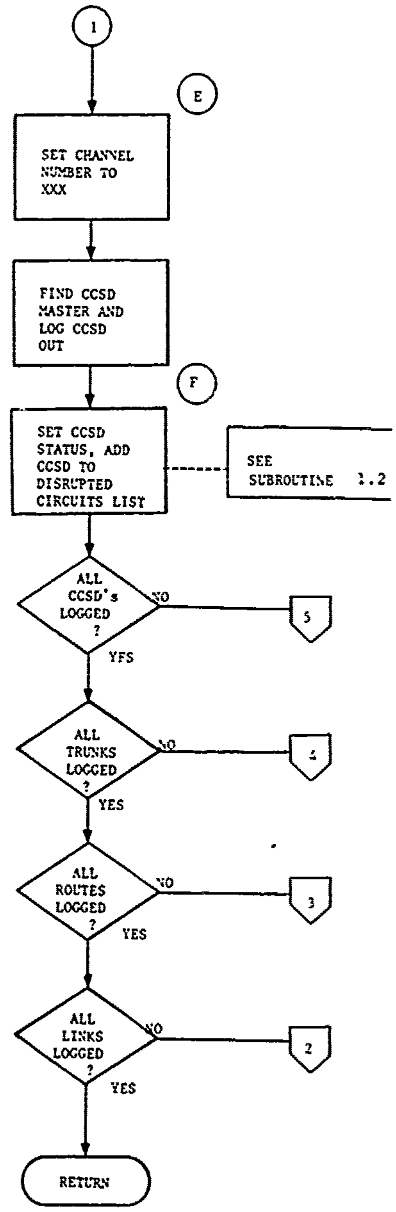


Figure 2-2. Subroutine 1.0 - Identify Disruptions
(sheet 2 of 2)

follows:

0 Operational
1 Disrupted but restorable
2 Not restorable due to disrupted end terminal
3 No reroute attempted because not in area of study
4 No reroute path available
5 TTY circuit - no reroute action at DC level
6 Not restorable due to low restoration priority
7 Circuit preempted by higher priority circuit

(D) This step determines the class of route, identifies the theater and updates the theater connectivity matrix.

(E) Setting the channel number to XXX serves as a flag to identify a disrupted trunk(s) when looking at CCSD connectivity.

(F) This step identifies non-restorable circuits due to status 2 and 6, adds restorable circuits to the disrupted circuit list and updates the critical control circuit connectivity matrix.

2.3 Subroutine 1.1 - Update Route Connectivity

The following is a narrative description of Figure 2.3.

This procedure maintains the current status of the routes within the system which can be used for rerouting. This information is maintained in a matrix called the Route Connectivity Matrix (RCMX). As routes are disrupted, they are removed from the matrix.

(A) This identifies the route as being disrupted but potentially restorable.

(B) There are two classes of routes. The route class is a static quantity which is entered manually in the route record when the data base is built. A class "O" route is one for

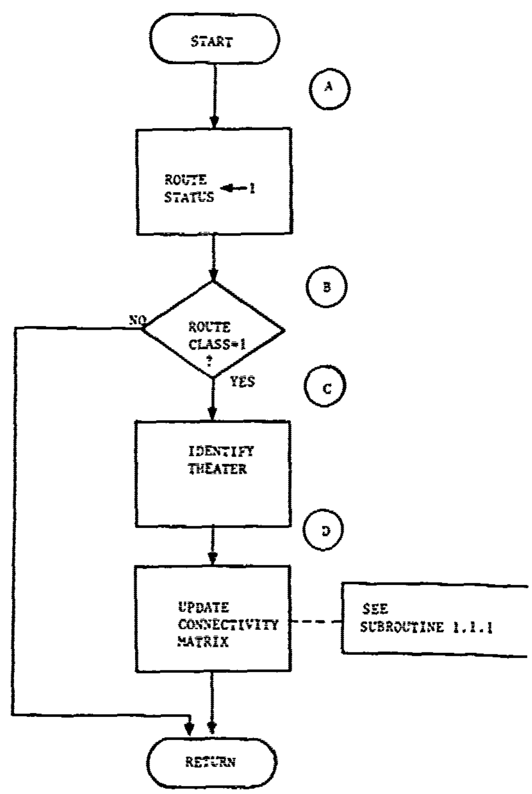


Figure 2.3 Subroutine 1.1 - Update Route Connectivity Matrix

which no possible reroute paths exist. Class "0" routes do not appear in the route connectivity matrix. Class "1" routes are those routes for which at least one possible reroute path exists. If it is a Class "0" route, no action is required.

C If it is a class one route, the theater(s) in which the route is located must be identified. This is necessary because each theater has its own route connectivity matrix.

D The route connectivity matrix is updated by removing this route.

2.4 Subroutine 1.1.1 - Update Theater Connectivity Matrix

Refer to Figure 2-4 in following this discussion.

The route connectivity matrix contains all the routes in a particular theater which can be used for rerouting purposes and is used for finding reroute paths. Each time one of these routes is di pted, it must be removed from the matrix, as it is no longe. vailable for rerouting. In the route connectivity matrix each route is listed twice, once for each end terminal. In the route master file, however, each route is only listed once. The route identifier is an 8 character group which (1) includes the two end terminals, (2) the theater and (3) a digit which identifies a particular route where multiple route connectivity exists between two points.

```
EXAMPLE:    CLO    MRE    2    1
             |      |     |    |
             |      |     |    |_____ Uniquely identifies this
             |      |     |           Coltano to Mt. Virgine route
             |      |     |__________ Identifies the theater
             |      |________________ Identifies the "to node"
             |_______________________ Identifies the "from node"
```

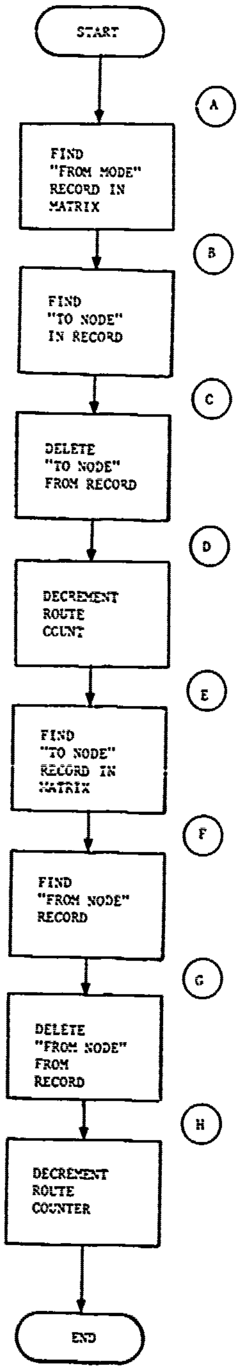


Figure 2-4. Subroutine 1.1.1 - Update Theater Connectivity Matrix

A convention has been established for naming the routes in the route master file in that the two end terminals are listed alphabetically in the route identifier. Thus when the end terminals of the route are known, such as DON and CLO, we know that the route identifier will be CLODON__ and not DONCLO__. In the route connectivity matrix the route identifier will be listed in one place with the end terminals in alphabetical order and in another place with the end terminals in reverse order. For example, the two listings for the CLOMRE21 route might appear as follows:

CLO	1 2	FEL 2 1	DON 2 1	HUM 2 1	MRE 2 1	MRE 2 2	....

⋮

MRE	1 0	CLO 2 1	CLO 2 2	DON 2 1	HUM 2 1	NPS 2 1	....

In the first entry the record key is the from node, CLO. In the second record entry the record key is the to node, MRE. In the first entry the route identifier can be constructed by simply concatenating CLO and MRE21. In the second entry, the route identifier cannot be constructed by simply concatenating MRE and CLO21 because they are not in alphabetical order. It is necessary to break CLO21 into CLO and 21 and then concatenate CLO, MRE and 21 to get CLOMRE21. The CLOMRE21 route example will be used in the following flow chart description for illustration purposes.

(A) Find the "from node" key in the matrix. That is, find the CLO record.

(B) Find the "to node" in "from node" record. That is, look for MRE21 in the CLO record.

(C) Delete "to node" from "from node" record. That is, delete MRE21.

(D) Decrement route count. Route count is the two digit number following the record key. It specifies the number of routes represented in the record. Thus, the CLO record now becomes:

CLO	1 1	FEL 2 1	DON 2 1	HUM 2 1	MRE 2 2	......

(E) Find the "to node" key in matrix. That is, find the MRE record.

(F) Find "from node" in "to node" record. The "from node" will be listed in the record as "CLO21". Therefore to construct the "from node" as it appears in the record, we must break CLOMRE21 into CLO, MRE and 21 and concatenate CLO and 21 to produce CLO21.

(G) Delete "from node" from "to node" record. (Same as C).

(H) Decrement route counter. (Same as D). Thus the MRE record becomes:

MRE	0 9	CLO 2 2	DON 2 1	HUM 2 1	NPS 2 1	....

2.5 Subroutine 1.2 - Set CCSD Status

Refer to Figure 2-5 in following this discussion.

This algorithm determines the status of each circuit affected by the scenario. All circuits with status 1 require reroute action and these circuits are placed in a disrupted circuits list for future use.

(A) If the multipoint flag is not equal to zero, then, it is a multipoint circuit and requires a different algorithm (B) for logging it out and setting the status.

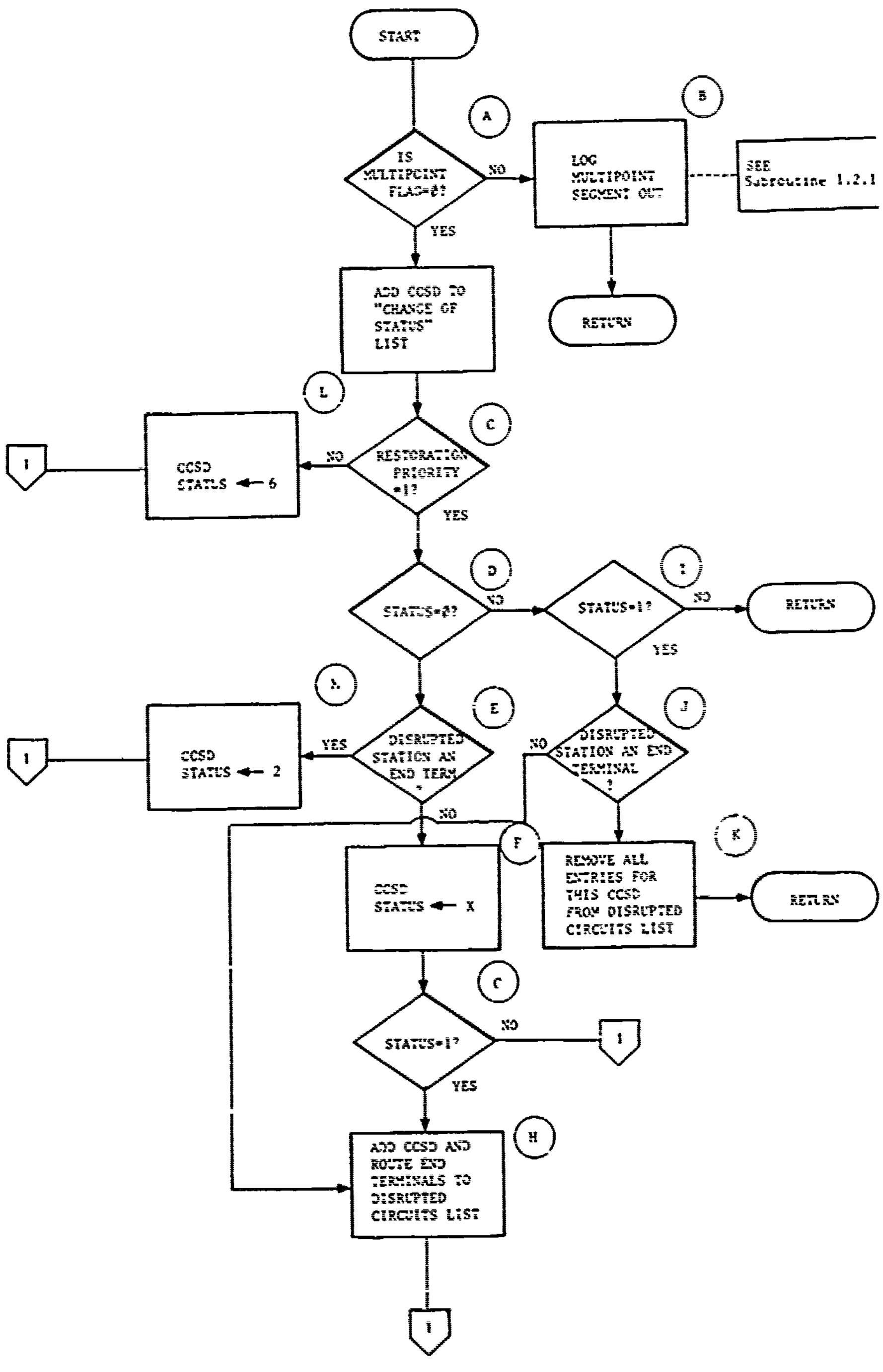


Figure 2-5. Subroutine 1.2 - Set CCSD Status (sheet 1 of 2)

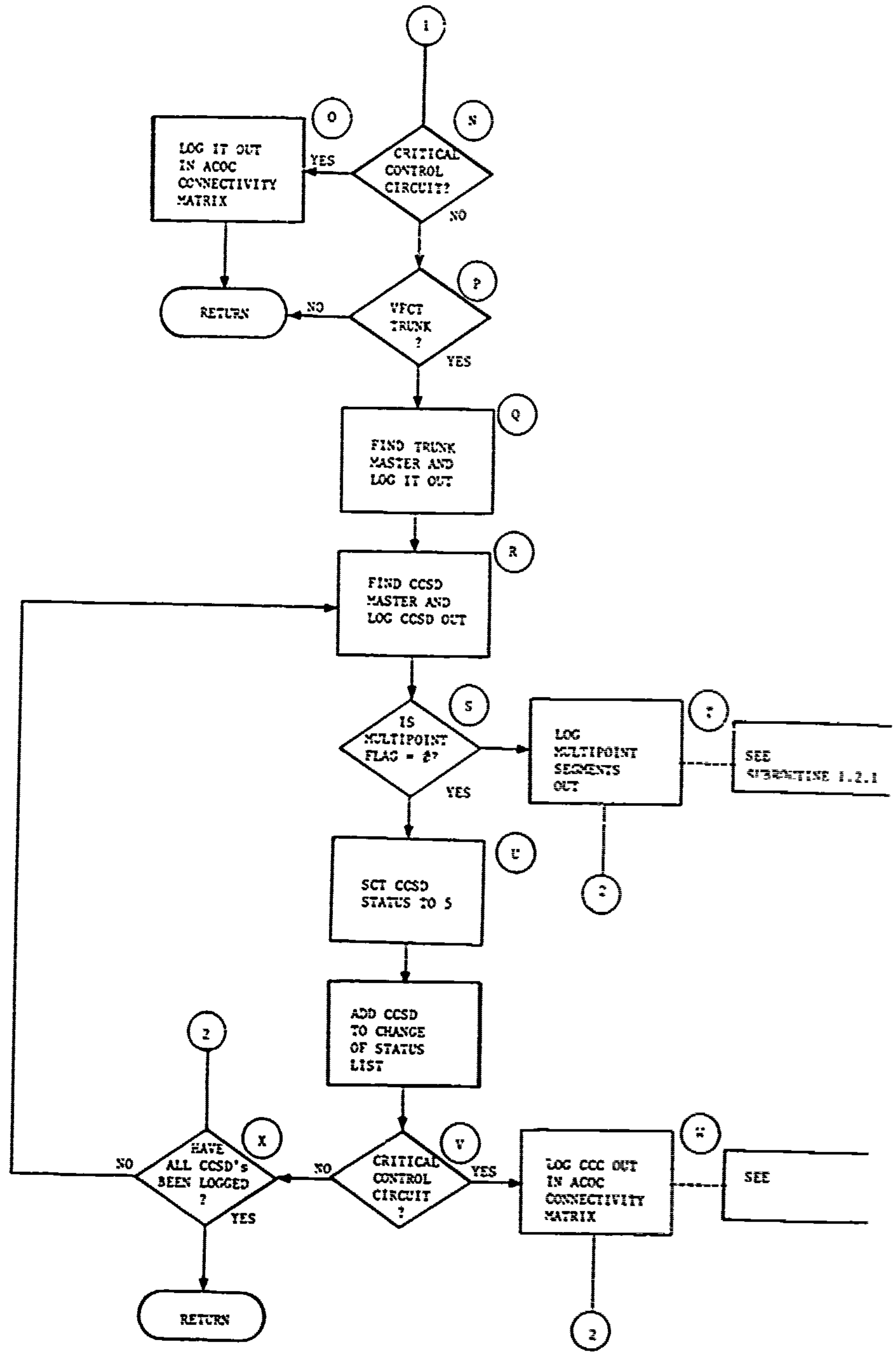


Figure 2-5. Subroutine 1.2 - Set CCSD Status (sheet 2 of 2)

C) If the restoration priority is not 1, then no reroute action will be taken and the CCSD status is (L) set to 6.

D) Is circuit status = 0? If the circuit status is not zero, then the circuit has already been logged out once and (I) is the next step to be performed.

E) Is disrupted station an end terminal? If the disrupted station is an end terminal, then the circuit cannot be restored and (M) the status is set to 2.

F) The CCSD status is set to the value in X (either 1 or 3).

G) Is CCSD status = 1? If the CCSD status is not 1, then no reroute action is taken.

H) The CCSD and route end terminals are added to the disrupted circuit list. Also the restoration priority. The CCSD, priority, and route end terminals are added to the disrupted circuit list for each disruption.

I) If the circuit has already been logged out and the status is NOT 1, then no further action is required.

J) If disrupted station is not an end terminal, then (H) this disruption is added to the disrupted circuits list.

K) If the disrupted station is an end terminal, then this circuit cannot be restored and all entries for this CCSD are removed from the disrupted circuits list.

N) The critical control circuit (CCC) flag is inserted manually when the data base is built. A "0" indicates it is not a CCC and a 1-5 indicates it is a CCC. All lines of communication which can be used for reporting status to the ACCC are considered CCC's. This includes those circuits designated as CCC's by DCA and also AUTOVON and AUTODIN access lines which can be used for status reporting.

(O) If it is a CCC, it is logged out in the ACOC connectivity matrix for that theater.

(P) If it is not a VFCT trunk, no further action is required.

(Q) If it is a VFCT, the trunk must be logged. This is the pseudo trunk corresponding to this VFCT circuit.

(R) Find CCSD master and log CCSD out.

(S) If the multipoint flag is not equal to zero, then the circuit is a multipoint circuit and a separate algorithm is needed to handle it.

(T) The multipoint segments are logged out individually.

(U) Status 5 is used on DC circuits to indicate they are out and reroute action is not being taken at a DC level.

(W) If it is a CCC, then it must be logged out in ACOC connectivity matrix for that theater.

(X) Have all CCSDs on the VFCT been logged?

(Y) When all CCSDs on the VFCT have been logged out, control is returned to the calling program.

2.6 Subroutine 1.2.1 - Log Multipoint Segments Out

Refer to Figure 2-6 in following this discussion.

Multipoint circuits are logged out differently than point-to-point circuits in that the path connecting each combination of two users is treated as a separate circuit when user-to-user connectivity is being considered.

(A) Each segment (or user to user path) is identified by a unique two digit number where the first two characters of the CCSD would normally be. For example, if DOOVWABC were a multipoint orderwire with three user to user path combinations, they would be identified as 01OVWABC,

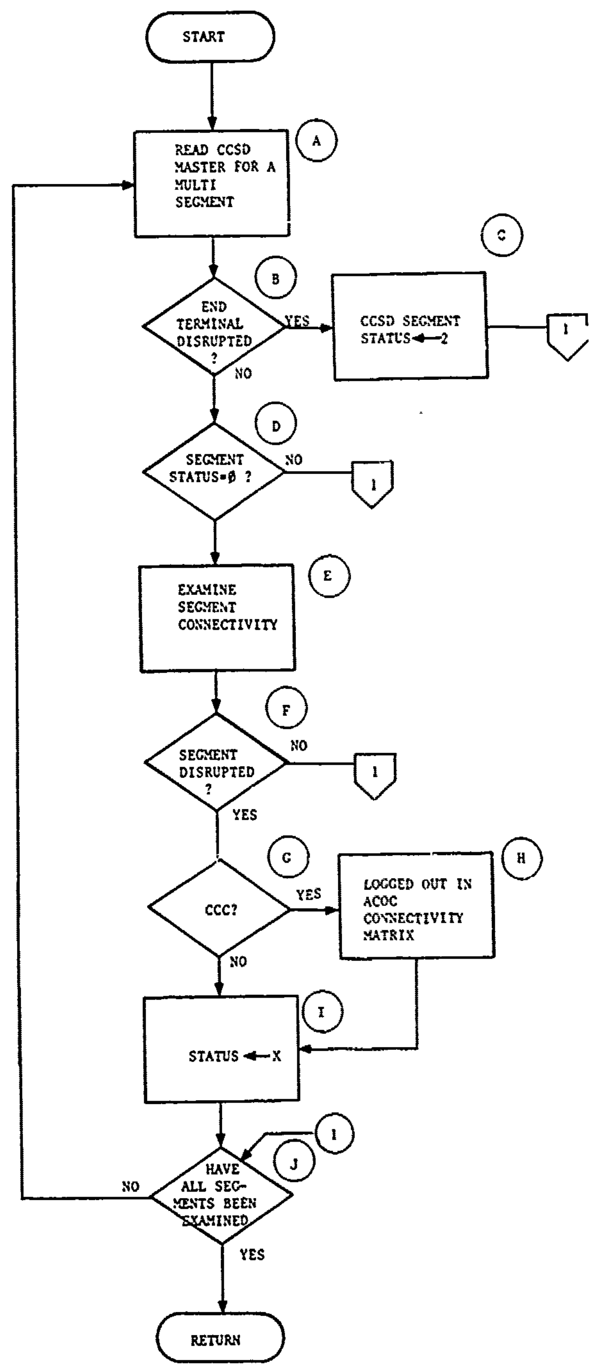


Figure 2-6 Subroutine 1.2.1 - Log Multipoint Circuit Out

020VWABC and 030VWABC. The multipoint flag in the parent CCSD Master record contains a two digit number which indicates how many segments there are. In the above example, the multipoint flag would be 03. To get from the segment CCSD Master back to the parent CCSD Master, the multipoint flag field in the segment CCSD Masters contain the first two characters of the CCSD. Thus the multipoint flags in the CCSD Masters for 010VWABC, 020VWABC and 030VWABC would each contain the characters "DO" for their multipoint flags.

(B) If the eight character location code provided by the scenario is the same as the location of either CCSD end terminal, it is assumed that the end terminal has been destroyed. If it was destroyed, the CCSD segment status is (C) set to 2.

(D) If the segment status does not equal zero, the segment is already logged out and the next step is (J) .

(E) Some segments of a multipoint may be disrupted whereas others may not. The only way to determine which segments are disrupted is to examine the individual CCSD segment connectivities and see if they are routed over the trunk that is presently being checked.

(F) If the segment is not disrupted, proceed to (J) .

(G) If the circuit is one of the TCF-ACOC reporting lines, then it is (H) logged out in the ACOC connectivity matrix.

(I) The status is set to the value of X (from Subroutine 1.0).

(J) After all segments have been examined, control is returned to the calling program.

2.7 Subroutine 1.2.2 - Log Circuit Out in ACOC Connectivity Matrix

Refer to Figure 2-7 in following this discussion.

The ACOC connectivity matrix is made up of one large matrix and two small matrices (or records) used to represent ACOC connectivity. The large matrix, REPORTING STATION CONNECTIVITY, contains all the circuits that can be used by the TCF reporting stations to communicate with the ACOC. These include direct connections via critical control circuits (CCCs) and indirect connections via the AUTODIN and AUTOVON networks. The two smaller matrices contain circuits connecting the ACOC to the networks. There are thus five classes of circuits:

1 Dedicated CCCs - Reporting station to ACOC

2 AUTODIN ACCESS LINES - Reporting station to AUTODIN network

3 AUTOVON ACCESS LINES - Reporting station to AUTOVON network

4 AUTODIN ACCESS LINES - ACOC to AUTODIN network

5 AUTOVON ACCESS LINES - ACOC to AUTOVON network

This subroutine identifies the class to which the circuit belongs and thus identifies the proper matrix for updating. The CCSD is then located and the in time is set to 9999. This is equivalent to the CCSD being out for the duration of the scenario.

The flow chart in Figure 2-7 is self explanatory. The flag referred to in the decision blocks of the flow chart is contained in the class code CKTMCLAS element of the circuit Master file. A class code of 0 indicates a non-ACOC circuit. Class codes 1, 2, 3, 4 and 5 identify CCC's.

2.8 Subroutine 2.0 - Check Orderwire Connectivity

Refer to Figure 2-8 in following this discussion.

When estimating circuit restoral times, it is necessary to establish the existence or non-existence of orderwire

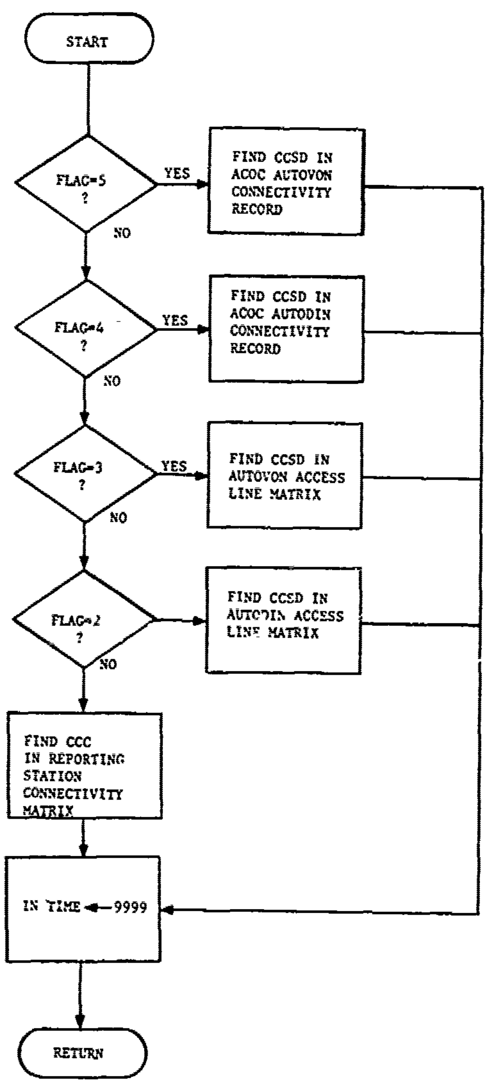


Figure 2-7. Subroutine 1.2.2 - Log Circuit Out in ACOC Connectivity

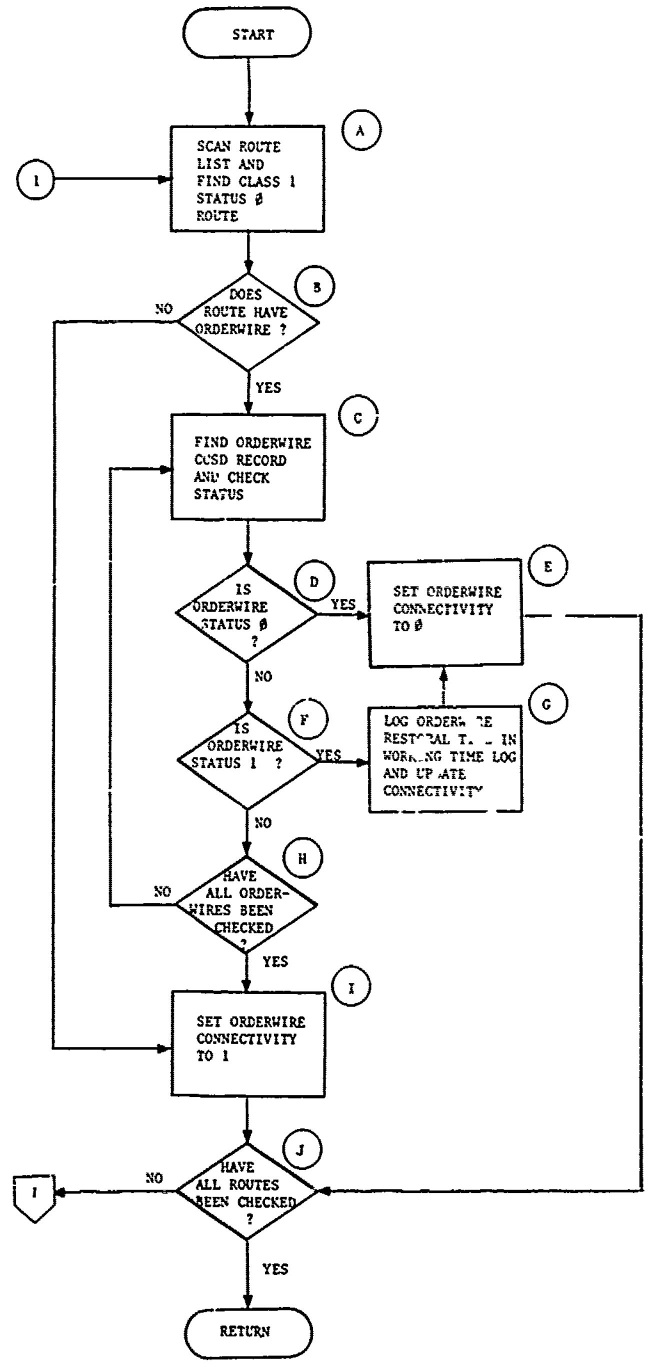


Figure 2-8. Subroutine 2.0 - Check Orderwire Connectivity

connectivity between the end terminals of a route in order to determine coordination and patching time. If there is an orderwire directly connecting the end terminals of a route, and it is operational, then coordination and patching times over that route are shorter than if orderwire connectivity does not exist.

(A) The route list is scanned and checked for orderwire connectivity on those routes which are class 1 (reroute paths exist) and have status 0 (operational). These are the routes which can be used for rerouting purposes.

(B) Does the route have orderwire connectivity under normal operating conditions? If the route has one or more pre-engineered orderwires directly connecting the end terminal of the route, then orderwire connectivity status is set to 1. The two conditions of orderwire connectivity status are as follows:

0 Orderwire connectivity exists
1 Orderwire connectivity does not exist

If the route normally has orderwire connectivity, then it is necessary next to determine if at least one orderwire is operational.

(C) The status of an orderwire is determined by refering to the CCSD record for that orderwire and checking the operational status. (See note at end of description)

(D) If the orderwire status is zero (operational) then orderwire connectivity exists for that route and (E) the orderwire connectivity status in the route record is set to zero.

(F) If the orderwire status is not zero, it must be determined if it is 1 (disrupted but restorable).

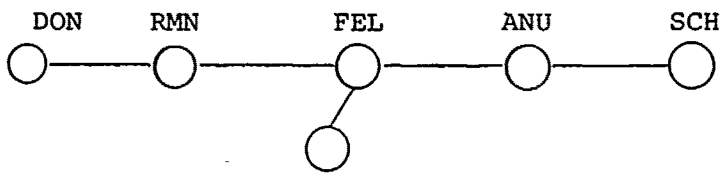
(G) If the status is 1, that is disrupted, then we assume that the reroute path for the orderwire will be over the route itself, and that because of its restoration priority (1A) it will be the first circuit restored over that route. The reroute patching and coordination time for the orderwire is logged at this time. The patching and coordination time begins on the sixth minute following the disruption and extends through the ninth minute. The first five minutes are for local damage assessment and will be logged later. The circuit is then logged in on the CCSD record and the connectivity is updated. Additional orderwires for that route which may be disrupted will be rerouted in the same manner as non-orderwire circuits.

(I) If all orderwires have been examined and their status is not 1 or 0, they are non-restorable and orderwire connectivity does not exist for this link. Connectivity status is then set to 1.

(J) If all routes have been examined, control is returned to the calling program.

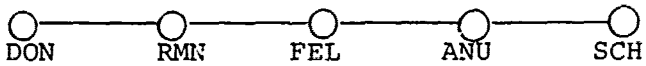
NOTE: Many orderwires are multipoint circuits. When entering the supporting orderwires in the CCSD Master Record, the unique orderwire segment CCSD must be entered. EXAMPLE:

MULTIPOINT CIRCUIT DOOVWABC

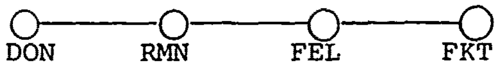


Users are DON, FKT, SCH.

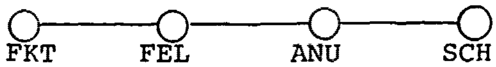
Segments are: 010VWABC DON-SCH



020VWABC DON-FKT



030VWABC FKT-SCH



Segments are identified uniquely by replacing the first two characters of the CCSD by a unique two digit number.

2.9 Subroutine 3.0 - Sort Circuits for Rerouting

Referring to Figure 2-9, this algorithm identifies the end points of reroute paths, identifies the circuits to be rerouted over each reroute path, and constructs a reroute path record (RPR) for each reroute path.

(A) The theater disrupted circuits list is called.

(B) A CCSD and the end terminals of its disruption are read from the disrupted circuits list.

(C) The remainder of the disrupted circuits list is scanned for another adjacent disruption. Two disruptions will be adjacent if either of the end terminals of one disruption are the same as either of the end terminals of another disruption.

EXAMPLE: Adjacent disruptions

#1	#2
DON-LKF	LKF-RSN or RSN-LKF

Non-Adjacent Disruptions

#1	#2
DON-LKF	RSN-GAB

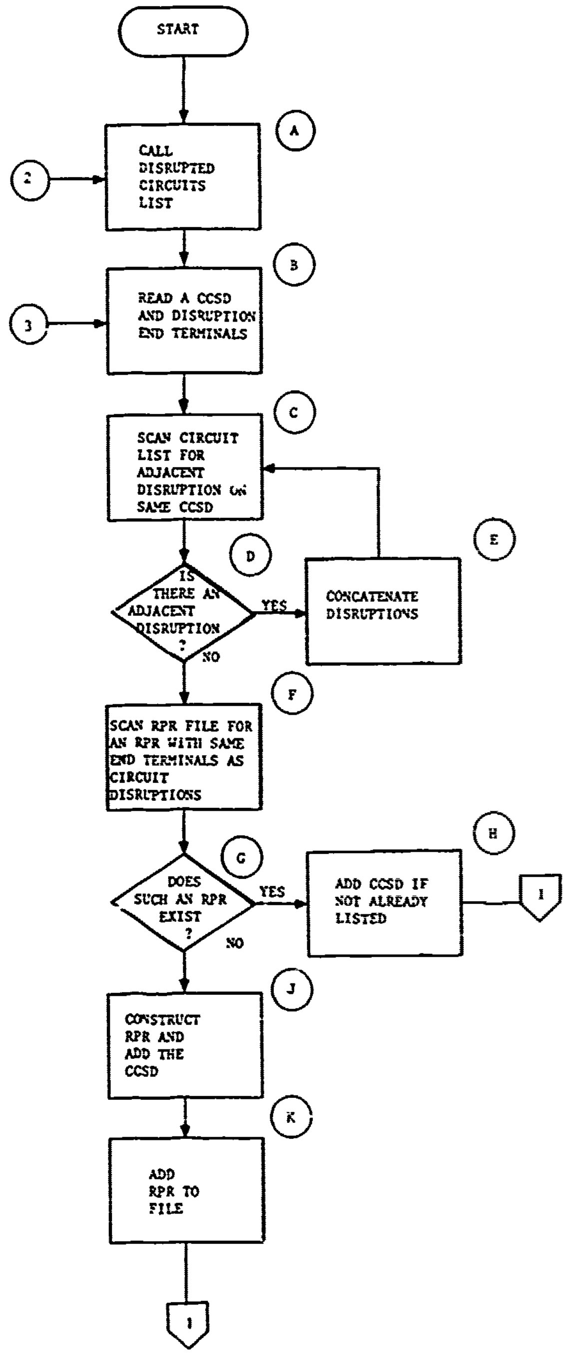


Figure 2-9. Subroutine 3.0 - Sort Circuits for Rerouting (sheet 1 of 2)

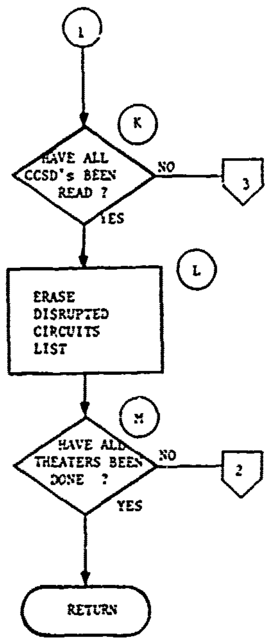


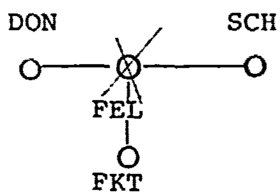
Figure 2-9. Subroutine 3.0 - Sort Circuits for Rerouting
(sheet 2 of 2)

D & F If there are adjacent disruptions, they are concatenated.

EXAMPLE: From the above example DON-LKF and RSN-LKF when concatenated become DON-RSN

This is necessary because adjacent disruptions are considered a single disruption for rerouting purposes. At this point the DON-LKF and RSN-LKF entries are erased from the list, since they have been accounted for in the concatenation process. It is then necessary to scan down the list again to see if there might be additional adjacent disruptions. It is also necessary to check for multipoint circuit hub disruptions.

EXAMPLE



Yields DON-FEL, FEL-SCH and FKT-FEL in disrupted circuit list.

RPRs must be generated for DON-SCH and DON-FKT, making DON the new hub.

F The RPR file is scanned for an RPR with the same end terminals as the disrupted circuit.

G & H If an RPR exists with the same end terminals as the disrupted circuit, then this circuit is added to the RPR if it is not already listed.

I If an existing RPR cannot be found for this circuit, one is constructed.

J The RPR is added to the RPR file.

K If all CCSDs have been read from the disrupted circuits list, then L the disrupted circuits list is erased, as all the information is in the RPRs and the list must be emptied for future use.

(M) After all the theaters have been completed, control is returned to the calling program.

2.10 Subroutine 4.0 - Reroute Circuits

Referring to Figure 2-10, this algorithm finds a reroute path for each reroute path record generated, or if no reroute path is available, it so indicates. Only circuits with a restoration priority of "1" are rerouted. It is assumed that tech controls will reroute over spare channels if they are available, and that they will readily preempt non priority one circuits when spares are not available. It is further assumed that tech controllers will not preempt lower priority-one circuits with higher priority-one circuits until every effort has been made to locate spare channels or non priority-one circuits. The first half of the procedure accomplishes an exhaustive search for reroute paths over spare channels and lower priority circuits. If a reroute path is not located then the second half of the procedure finds reroute paths by preempting lower priority-one circuits.

(A) The Reroute Path Record File is called.

(B) Reroute path length is initialized to zero in order to search for shortest reroute.

(C) The path length is incremented. The "path length" specifies the depth to which a reroute path search will be conducted. That is, it specifies the number of routes in a reroute path. The algorithm begins by looking for all reroute paths of length 1. It then searches for paths of length 2, then 3, etc., up to some maximum length. (Maximum length is specified by the operator and will normally be 4 to 6). This is based on the assumption that tech controllers will reroute circuits by the shortest paths available first, and reroute longer path circuits later.

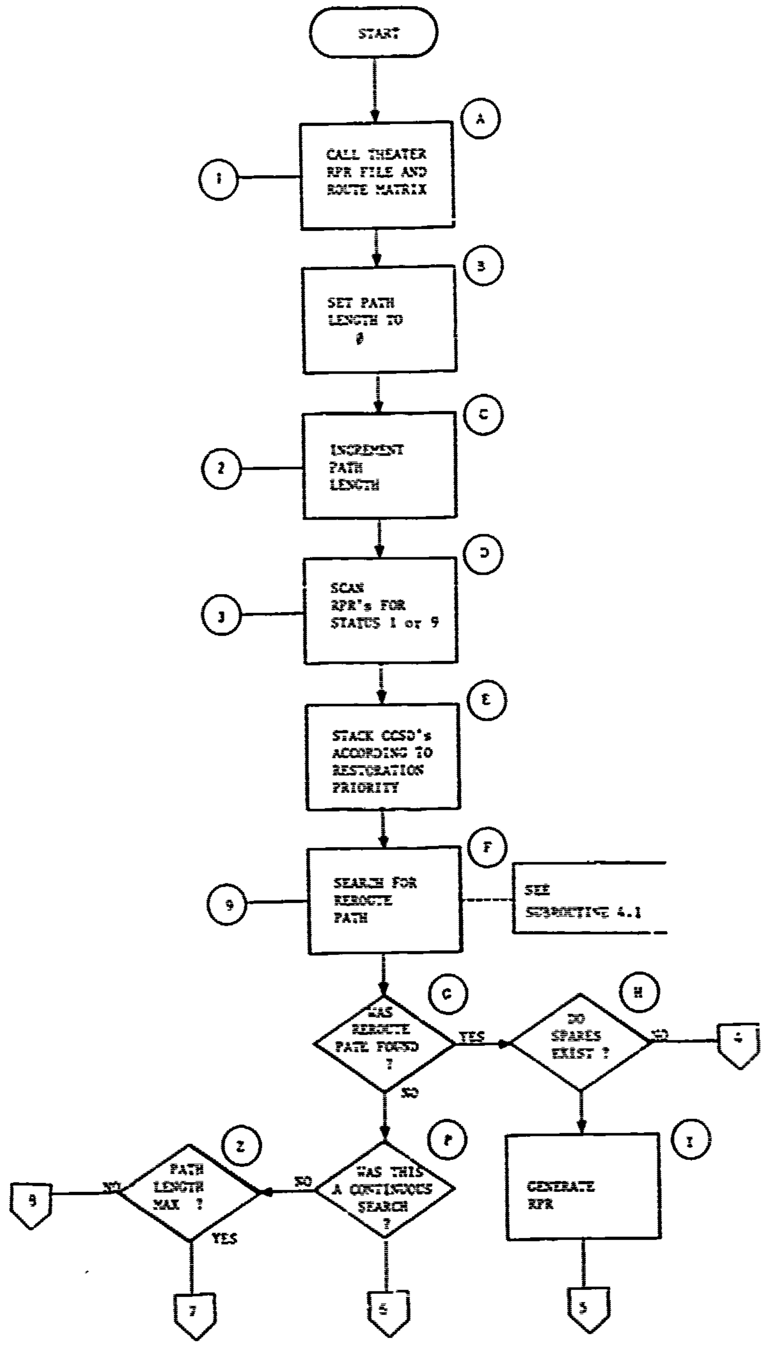


Figure 2-10. Subroutine 4.0 - Reroute Circuits (sheet 1 of 5)

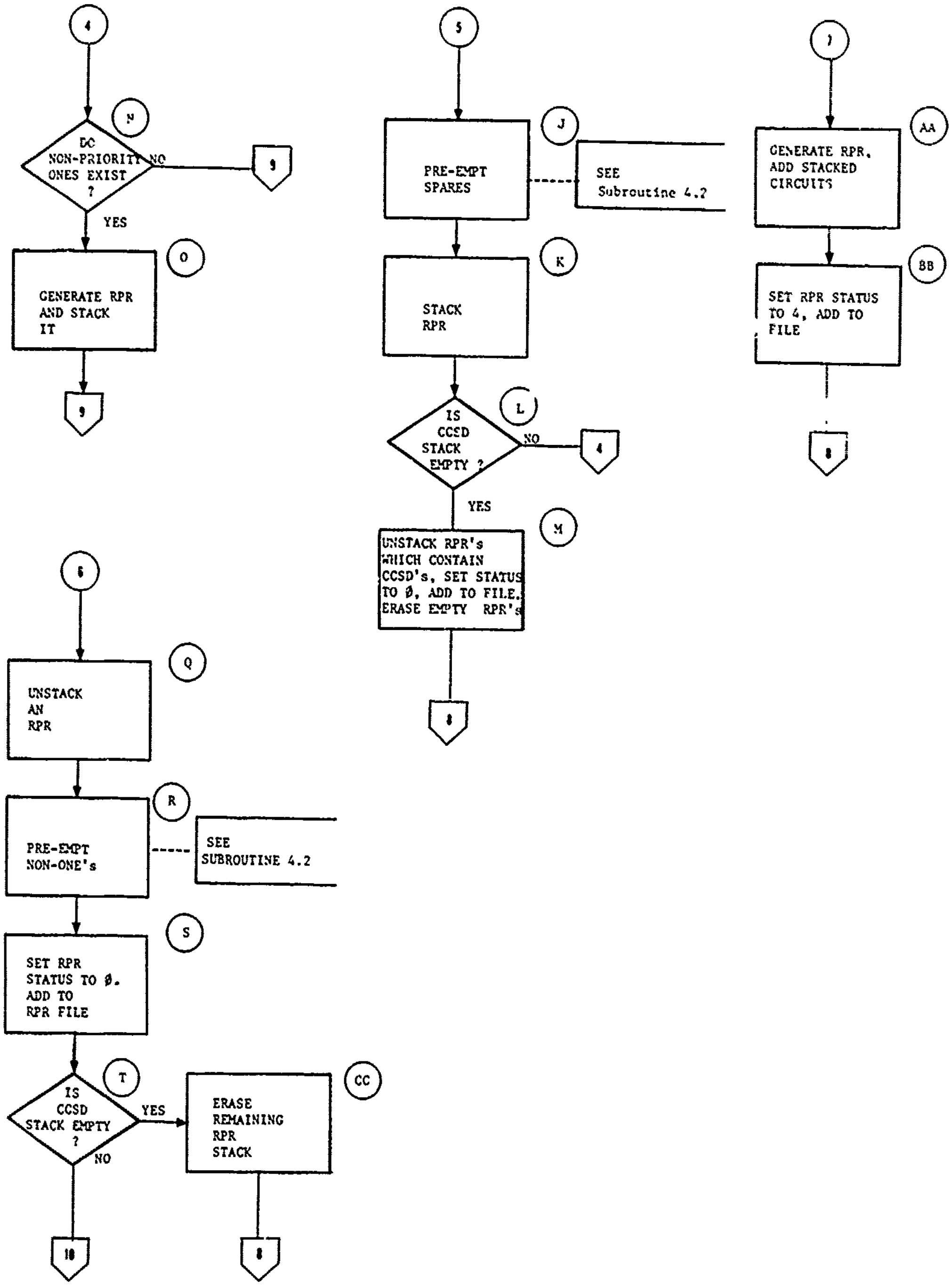


Figure 2-10. Subroutine 4.0 - Reroute Circuits (sheet 2 of 5)

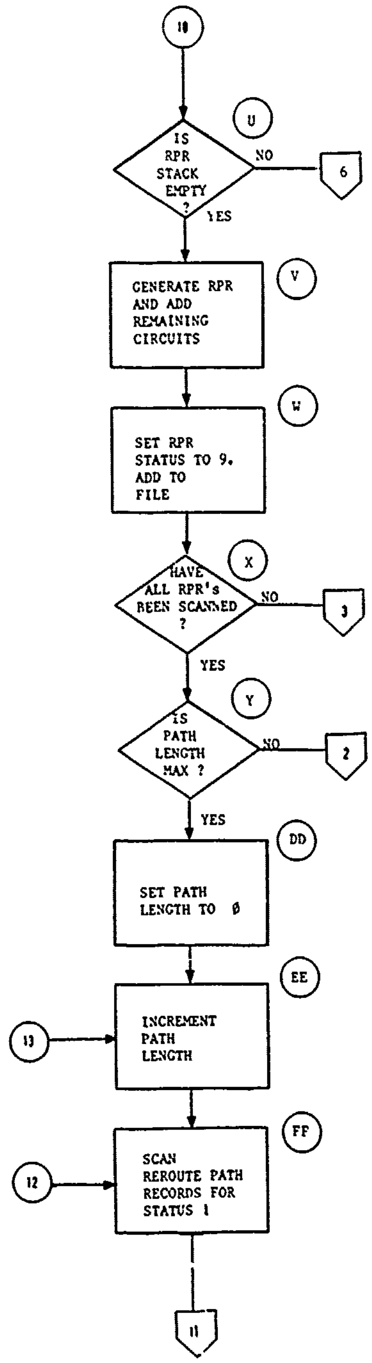


Figure 2-10. Subroutine 4.0 - Reroute Circuits (sheet 3 of 5)

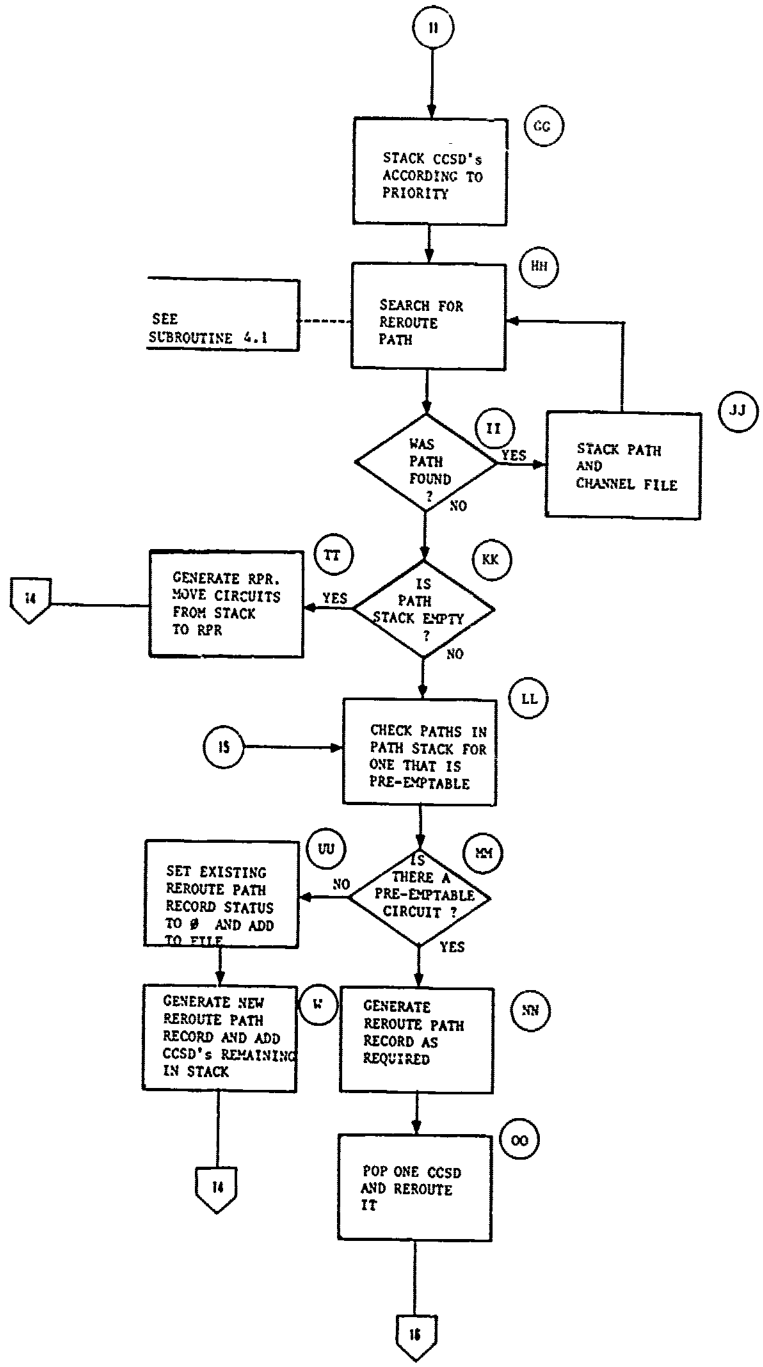


Figure 2-10. Subroutine 4.0 - Reroute Circuits (sheet 4 of 5)

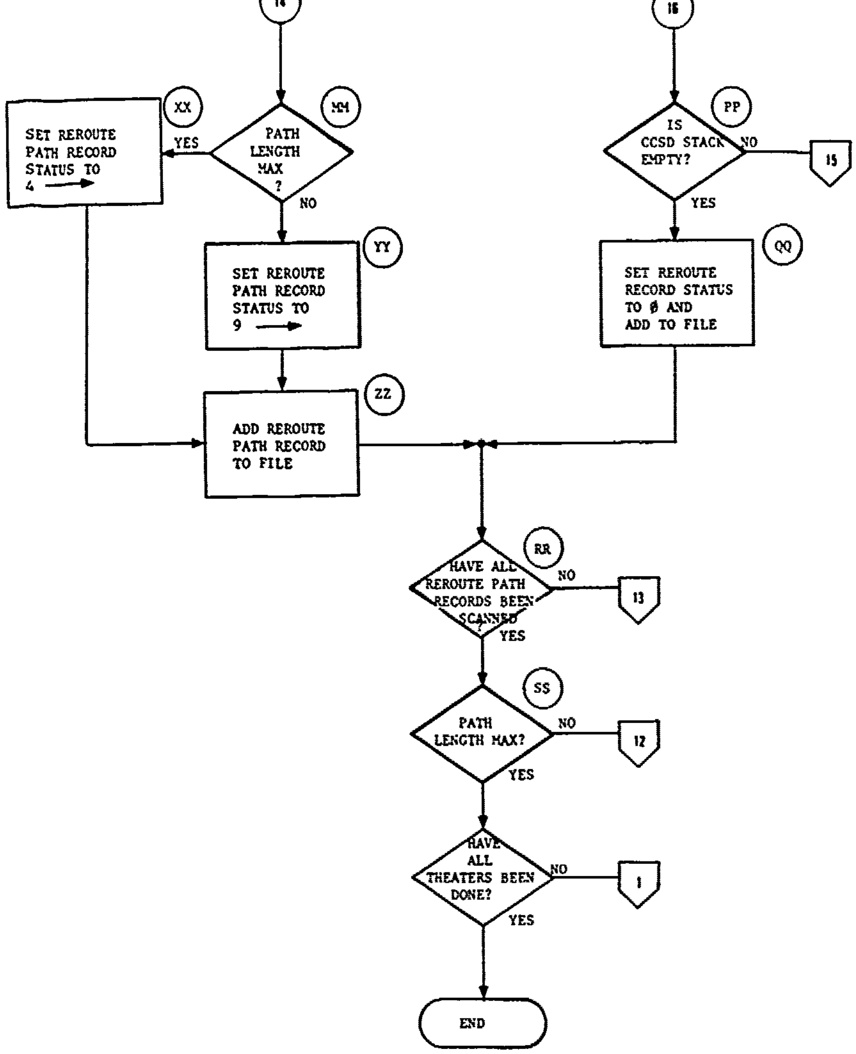


Figure 2-10. Subroutine 4.0 - Reroute Circuits (sheet 5 of 5)

(D) Reroute path records are scanned for status 1. That is, disrupted but restorable. Also it must identify reroute path records with status 9. Status 9 indicates that a path search has already been accomplished for the specified path length and another search is not required until the path length is incremented. As status 9 RPRs are generated they are added to the bottom of the list. Thus, the status 9 prevents an infinite loop. Therefore, when a status 9 is encountered, the status is changed to 1 (so it will be caught the next time around after incrementing the path length) and the next record in the list is examined.

(E) CCSDs are sorted according to restoration priority. The CCSDs and restoration priorities are moved from the reroute path record and placed in a list in descending order according to restoration priority with the highest priority on top. This insures that the highest priority circuits will be rerouted first.

(F) This subroutine performs a "next neighbor" search for a reroute path of a specified length between the two end points which appear on the reroute path record. This subroutine must remember whether the search is an initial search or a continued search. After the first path of a specified length for an RPR is found (initial search) the procedure must recall where it stopped so that it can continue on later to look for additional paths of the same length for the same RPR (continued searches). This continues until all the reroute paths for the RPR, at the specified length, have been found, or all the CCSDs on that RPR have been rerouted.

(G) Was a reroute path found?

(H) If a reroute path was found, it must be determined if spare channels exist on the reroute path. This is determined by checking for spare channels on each of the routes on the reroute path. The number of spare channels available is equal to the number on the route with the fewest spare channels.

(I) A reroute path record is generated and the reroute path and path length are entered.

(J) CCSDs and RPs are moved from the stack to the reroute path record until all the spare channels have been filled or until the CCSD stack is empty. The rerouted circuits are added to the trunk/channel on which they were rerouted for each route in the reroute path and the channel fill for each affected trunk and route is updated. The channel fill that requires updating at this point is the number of spare channels, number of non-priority one circuits, number of priority one circuits, highest and lowest restoration priority of routes, and highest and lowest restoration priority on affected trunks.

(K) The reroute path record is stacked. It is necessary to save the reroute path record because it may be necessary to come back to it and later preempt non priority-one circuits on that path if all the CCSDs cannot be rerouted over spare channels. For the same reason it is necessary to also save the number of non priority-one circuits on each reroute path found.

(L) Is the CCSD stack empty?

(M) If the CCSD stack is empty, all the reroute path records are unstacked and moved to the reroute path record file. Before adding them to the file, the status on each record is set to zero, which indicates that reroute action has been completed on those records.

(N) If the CCSD stack is not empty and a reroute path is found which does not have spare channels, it must be determined if it has non priority-one circuits. If it doesn't have non priority one circuits it is discarded and (F) a search for another reroute path is conducted. If it does have non priority-one circuits, (O) the path is saved by generating a reroute path record.

(O) The path is saved because it may be needed if there aren't enough spare channels to reroute all the CCSDs.

(P) If this was not a continuing search, then not a single reroute path was found between the two points in question. If it was a continuing search, then reroute paths were found but they did not contain enough spare channels to handle all the CCSDs.

(Q) If the reroute path record stack is not empty, a reroute path record and its channel fill (number of non priority-one circuits) are removed from the stack to facilitate preemption of non priority-one circuits.

(R) Non priority-one circuits are preempted until the supply is exhausted or until the CCSD stack is empty. When a circuit is preempted, it must be reflected in the status block in the CCSD Master record and the connectivity reassigned to spare. If the CCSD status is not already set to 2, then the status is changed to 7. If the status is 2, it's already out due to a disrupted end terminal and the status should not be changed. The preempted CCSD and restoration priority in the Trunk Master records of the reroute path are then replaced by the preempting CCSD and restoration priority, and the channel file is updated. The preempting circuits are then added to the reroute path record.

(S) The reroute path record status is set to 0 and the record is added to the RPR file.

(T) If the CCSD stack is empty (CC), the remaining reroute path records in the stack are erased. If the stack is not empty, then (V) the reroute path record stack is checked to see if it is empty.

(U) Is the reroute path record stack empty? If the reroute path record stack is empty, then (V) a reroute path record is generated.

(W) If the path stack is empty, the remaining CCSDs in the stack are added to the reroute path record just generated, the reroute path record status is set to 9 and it is added to the reroute path record file. Recall that the status was set to 9 so that when this reroute path record is encountered again, another reroute path search is not conducted until after the path length is incremented. When the status 9 is encountered, the status is changed to one so that action may be taken after the path length is incremented.

(X) If the entire reroute path record file has been scanned, the path length is checked to see if it has reached the maximum allowable value. If the entire file has not been read, (B) the next record is read.

(Y) If the maximum path length has been reached, then the remaining circuits are rerouted by preempting lower priority-one circuits. If the maximum path length has not been reached then (C) the path length is incremented and the search continues.

(Z) If a reroute path was not found (G) and it was not a continued search (P) then no reroute path exists at the current path length. The current path length is checked to see if it is the maximum allowed. If it is not, then (X) the reroute path records are checked.

(AA) If the current path length is the maximum allowed, then no reroute path exists between the two end points.

(BB) The reroute path record status is set to 4 (no reroute path available) and it is returned to the reroute path record file.

(CC) If the CCSD stack is empty then no other CCSDs have to be rerouted. All the remaining reroute path records generated can then be discarded.

(DD) The path length is initialized to zero.

(EE) Path length is incremented by one.

(FF) Reroute path records are scanned for a status 1. Again, as status 9's are encountered they are changed to 1's before proceeding to the next record.

(GG) The CCSDs are removed from the reroute path record and placed in the CCSD stack, highest priority on top.

(HH) A reroute path search is conducted. As above, there are initial searches and continued searches.

(II) If a path was found (JJ) it is placed in the path stack. Also the restoration priority of the lowest preemptable on the path is stacked in the path stack. The lowest preemptable is the lowest priority on that route which has the highest low priority. For example, if the lowest priorities for a five route path are as follows

ROUTE 1	ROUTE2	ROUTE 3	ROUTE 4	ROUTE 5
1G	SPARE	1H	Non-one	1E

The lowest priority preemptable circuit on this reroute path is 1E.

KK If the path stack is empty no reroute path was found. If the path stack is not empty then one or more paths were found.

LL The priority of the CCSD at the top of the CCSD stack is compared to the priority stored with each path in the path stack. If the priority in the path stack is higher than the CCSD priority, this path cannot be used. If a path with a lower priority is found, that path can be used to reroute a circuit.

NN If there is a path that can be used, a reroute path record is generated for that path if there isn't already one. The first time through this loop the reroute path record that was picked up in step FF is used. On subsequent passes through the loop CCSDs are added to that reroute path record for additional circuits rerouted over that path. However, if on a subsequent pass through the loop, a reroute is established over a different path, then a new reroute path record must be generated for that path. In the following example the priorities in a CCSD stack are shown in descending order, and the priorities in three potential reroute paths are shown. The circled numbers represent the order in which the CCSDs in the CCSD stack would be rerouted and the same number appears beside the priority that would be preempted in the path.

CCSD STACK	PATH #1	PATH #2	PATH #3
1A 1	1H 1→1A	1B	1E 5→1E
1A 2	1H 2→1A	1B	1D
1B 3	1G 3→1B	1A	1C
1C 4	1F 4→1C	1A	1B
1E 5	1A	1A	1A
1G	1A	1A	1A

In the example, path # 1 is the first one encountered with lower priority circuits and the original reroute path record would be used for that path. For the first four circuits, path #1 would have the lowest priority preemptable channels. For the 5th circuit, path #3 would be the only path with a preemptable channel. For the last circuit in the CCSD stack, none of the paths would have a lower priority channel and it could not be rerouted.

OO A CCSD is popped from the stack and it is rerouted over the path with the lowest priority, preempting the lowest priority on each route in the path. After each such preemption it is necessary to again determine what is the lowest priority channel remaining on that path. In the example, after the first CCSD was rerouted, the lowest priority on path #1 was still 1H. After the second preemption the lowest priority was 1G. After the third, it was 1F. And after the fourth, it was 1C.

PP If the CCSD stack is not empty, LL another preemptable channel is sought.

QQ If the CCSD stack is empty, the status is set to 0 on all the reroute path records used in rerouting these circuits, and the reroute path records are moved back to the reroute path record file.

RR If all the records have not been scanned, FF the next record is examined.

SS If they have, then it is determined if the maximum path length has been reached. If it has, control is returned to the calling program. If it hasn't, go back to EE .

TT If a reroute path was never found, the CCSDs are moved from the stack back to the reroute path record.

UU If there aren't any more preemptable channels, the reroute path record status is set to 0 on any paths on which circuits were rerouted and return these reroute path records to the file. Note that it may not have been possible to reroute any of the CCSDs in which case there won't be any reroute path records to return to the file.

VV Any circuits remaining in the CCSD stack must be put on a reroute path record for eventual return to the file. If no CCSDs were rerouted the same reroute path record started with at FF can be used. However, if this reroute path record has already been used, a new one must be generated.

WW It is determined if the path length is the maximum allowed.

XX If it is, the status of the reroute path record is set to 4 (no reroute path available).

YY If it isn't, the status is set to 9.

ZZ The reroute path record is added to the file.

2.11 Subroutine 4.1 - Path Search

Referring to Figure 2-11, this subroutine performs the actual reroute path search. There are two types of search, an initial search and a continuing search. Referring to the calling program, subroutine 4.0, the initial search is the first search conducted for a particular RPR. After a reroute path is found, it is outputted to the calling program and then a new search for additional paths is conducted where the old search left off. This procedure is repeated until all paths at a particular path length between two points have been found.

A If this is a continued search, the top FMNODE and TONODE are popped from the stack and the process continues it N.

B On the initial search the stack is cleared of any residue.

C Depth$\leftarrow$1. The depth is an indicator of the current depth of the search. That is, how many routes deep, from the FM-END, has the search progressed.

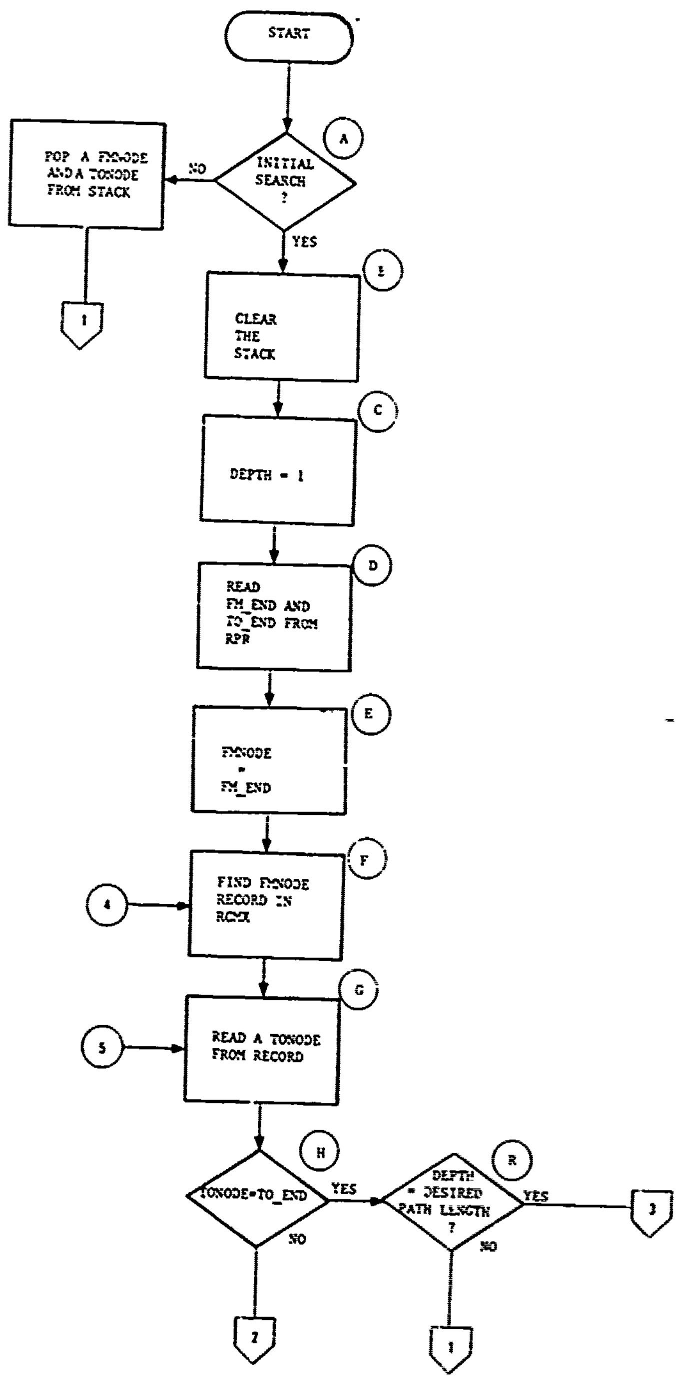


Figure 2-11. Subroutine 4.1 - Path Search (sheet 1 of 2)

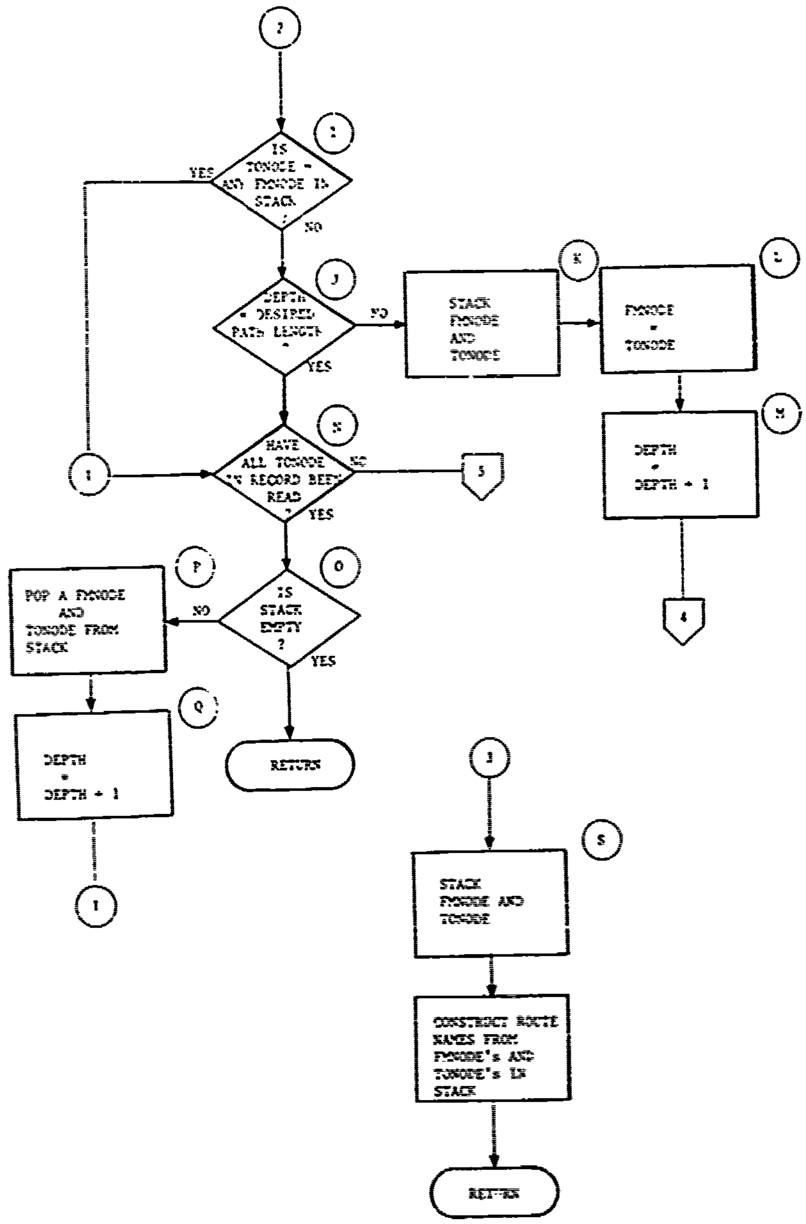


Figure 2-11. Subroutine 4.1 - Path Search (sheet 2 of 2)

(D) The FM-END and TO_END are the disruption end points. These are the two points between which a reroute path must be found.

(E) FMNODE = FM-END. The FMNODE (from node) is the node from which the program is currently looking. The first FMNODE naturally will be the starting point, the FM-END.

(F) The FMNODE record is found in the Route Connectivity Matrix (RCMX).

(G) A TONODE is read from the FMNODE RCMX record.

(H) If the TONODE is equal to the TO_END, a reroute path has been found and the program proceeds to (S) .

(I) It is necessary to check if the TONQDE is any FMNODE in the stack in order to avoid searching in a circle. If the TONODE is already in the stack as a FMNODE, then (N) the algorithm proceeds to look at the next TONODE on the FMNODE RCMX record.

(J) The desired path length is that path length determined in the calling program, subroutine 4.0. If the depth is equal to the path length then it doesn't search any deeper, but proceeds to (N) and looks at the next TONODE on the record.

(K) The FMNODE and TONODE are stacked, as the desired path length has not been reached and it is necessary to look one route deeper.

(L) The old TONODE is used as the new FMNODE.

(M) The depth is incremented.

(N) If all TONODES in the record have not been read, proceed to (G) and read the next one.

(O) If the stack is empty, the search has been exhausted, and control is returned to the calling program.

(P) FMNODE and TONODE are popped from the stack and the search continues from the next TONODE on the previous FMNODE record. NOTE: It not only pops, but it must erase the FMNODE and TONODE from the stack since they must not be present in Step (I) .

(Q) The depth is decremented.

(R) After having found a path in (H) , it now must be determined if the path is the proper length. For example, there may be four route paths which cannot be used because they contain all high priority circuits. When a subsequent search for five route paths is conducted the four route paths will be encountered again, but they must be ignored, since it has already been determined that they cannot be used. If it is not the desired length, the program proceeds to (N) and looks at the next TONODE.

(S) If a path of the desired length has been found, then the present FMNODE and TONODE are stacked so that the entire reroute path is loaded in the stack.

(T) Route names are constructed from FMNODEs and TONODEs in the stack. The subroutine 1.1.1 description contains a discussion on route name construction.
NOTE: The contents of the stack are not disturbed, but the route names are loaded into a buffer and outputted to the calling program.

2.12 Subroutine 4.2 - Preempt Non Priority-One Circuits

Referring to Figure 2-12, this procedure preempts non priority-one circuits, and for the circuit being rerouted, it updates the connectivity by removing the disrupted trunk/channel and entering in its place the trunk/channels of the reroute path.

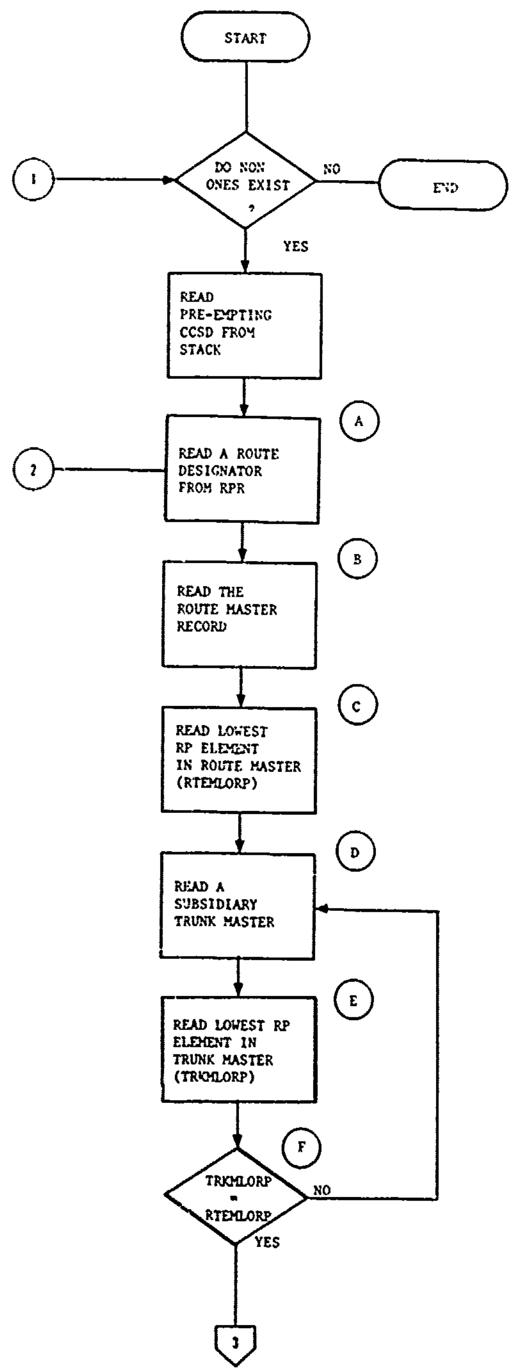


Figure 2-12. Subroutine 4.2 - Preempt Non Priority-One Circuits
(sheet 1 of 4)

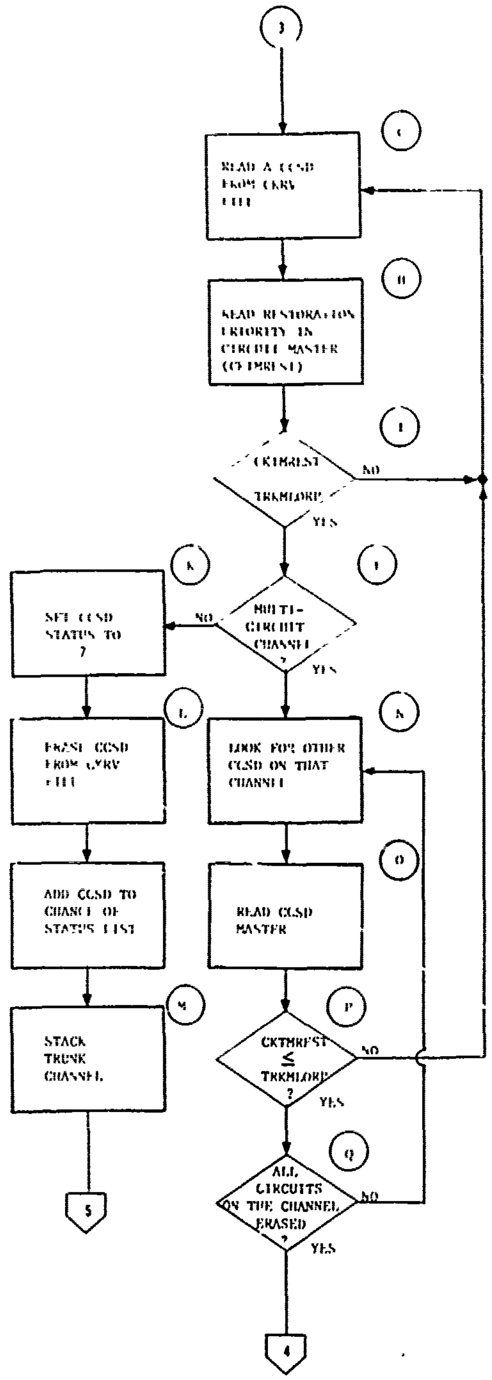


Figure 2-12. Subroutine 4.2 - Preempt Non Priority-One Circuits
(sheet 2 of 4)

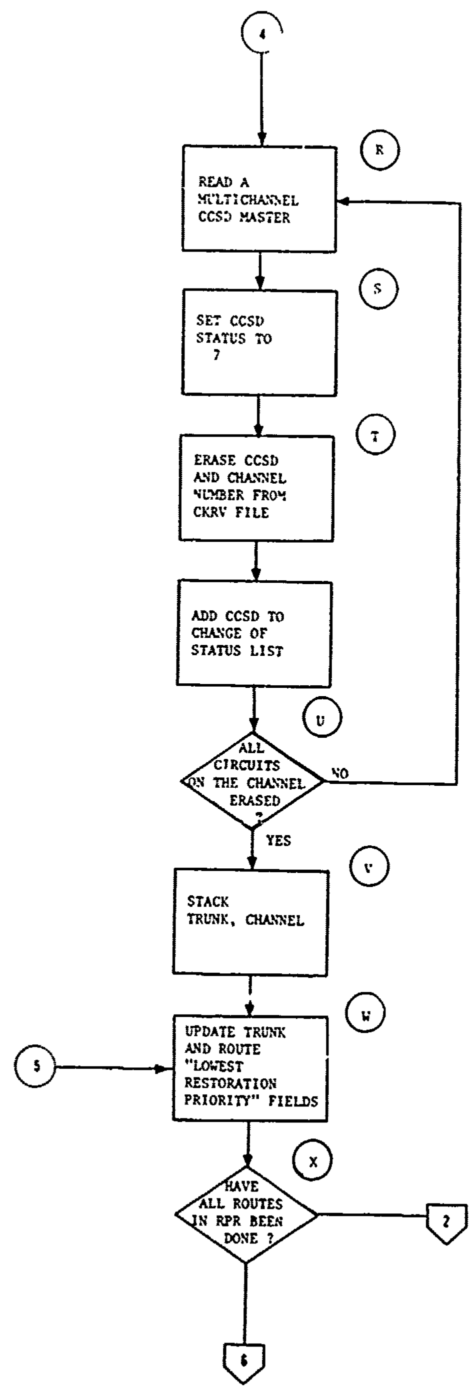


Figure 2-12. Subroutine 4.2 - Preempt Non Priority-One Circuits (sheet 3 of 4)

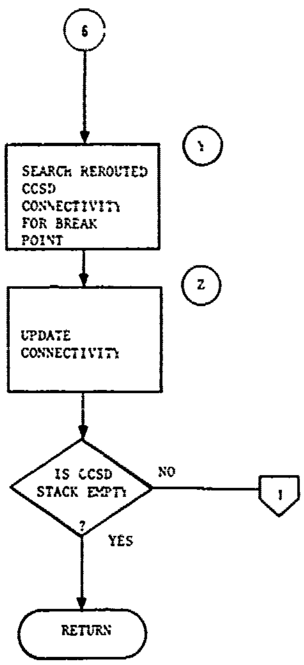


Figure 2-12. Subroutine 4.2 - Preempt Non Priority-One Circuits
(sheet 4 of 4)

(A) A route designator is read from the RPR. This is one of the routes of the reroute path.

(B) This route master record is read.

(C) The lowest restoration priority field (RTEMLORP) is read. This provides the value of lowest restoration priority on the route.

(D) A subsidiary trunk master is read.

(E) The lowest restoration priority field (TRKMLORP) is read. This provides the value of the lowest restoration priority on the trunk.

(F) TRKMLORP = RTEMLORP? The lowest priority on the route must equal the lowest priority on at least one of its trunks. A search is conducted until the first such trunk is found.

(G) After having found the trunk, it is necessary to search for the circuit with that priority.

(H) The CCSD restoration priority is read.

(I) CKTMREST = TRKMLORP? In other words, is this the CCSD with the lowest priority. NOTE: There may be more than one. The first one found will suffice.

(J) Is this a multicircuit channel? Some VF channels will carry more than one data circuit or several time sharing VF circuit. If this channel is to be preempted, all the circuits on it will be preempted. If it is a multi-circuit channel, the program proceeds to (N) .

(K) The CCSD status is set to 7. If this isn't a multicircuit channel, then it is immediately preempted. When a circuit is preempted the status is set to 7 in the CCSD master.

(L) Erase the CCSD from CKRV file. Since the circuit is preempted, its connectivity is no longer of any concern.

(M) The trunk and channel are stacked so that the connectivity of the circuit being rerouted can be updated after all the trunk/channels on the reroute path have been found.

(N) If the channel was a multicircuit channel, the other circuits on it must be checked to make sure none of them are of a higher priority than that which is to preempt it.

(O) The CCSD Master is read.

(P) CKTMREST = TRKMLORP. In other words, is the restoration priority of all the circuit(s) on the channel equal to or lower than the preempting priority. If not, then this was not the channel being sought, and the program goes back to (G) and looks at the next one.

(Q) If all circuits on the channel have been checked and it is found that all are equal to or lower than the preempting priority, then the channel can be preempted.

(R)(S)(T) & (U) All those circuits are removed from the trunk and the CCSD Master status is set to 7, preempted.

(V) The trunk channel is stacked.

(W) The channel fill on the routes and the trunk are updated.

(X) After the trunk-channels have been found on each route, the program proceeds to update the connectivity of the rerouted circuit.

(Y) The rerouted CCSD connectivity is searched for the break point. The disrupted trunk/channels are identified by the characters XXX where the channel number should be.

(Z) The disrupted trunk(s) are removed from the connectivity and the reroute path trunk-channels are inserted from the stack.

2.13 Subroutine 4.3 - Preempt Spares

Referring to Figure 2-13, this procedure preempts spare channels, and for the circuit being rerouted, it updates the connectivity by removing the disrupted trunk/channel and entering in its place the trunk/channels of the reroute path.

(A) This check is necessary to determine when all the spares on the reroute path have been used up.

(B) Preempting CCSD is read from CCSD stack.

(C) A route designator is read from the RPR.

(D) The route master record is read.

(E) A subsidiary trunk master record is read.

(F) "Lowest priority" field (TRKMLORP) is read. Spare channels will be assigned a restoration priority such as "SP" or "SA".

(G) If the lowest priority is spare, then a trunk has been found that can be used.

(H) The spare CCSD is erased from the CKRV file.

(I) All the trunk channels used for rerouting are saved so that in (M) they can be used to update the connectivity of the circuit being rerouted.

(J) Have all routes on RPR been done? In other words, has the rerouted circuit been put on all the routes in the reroute path?

(K) Trunk and route channel fill are updated. The number of spare channels on the trunk and route have to be reduced by one, the highest or lowest priority changed, if necessary, and the number of one priority circuits incremented by one.

(L) Rerouted CCSD connectivity is searched for disruption point. That is, disruption that is being rerouting around is located in the connectivity.

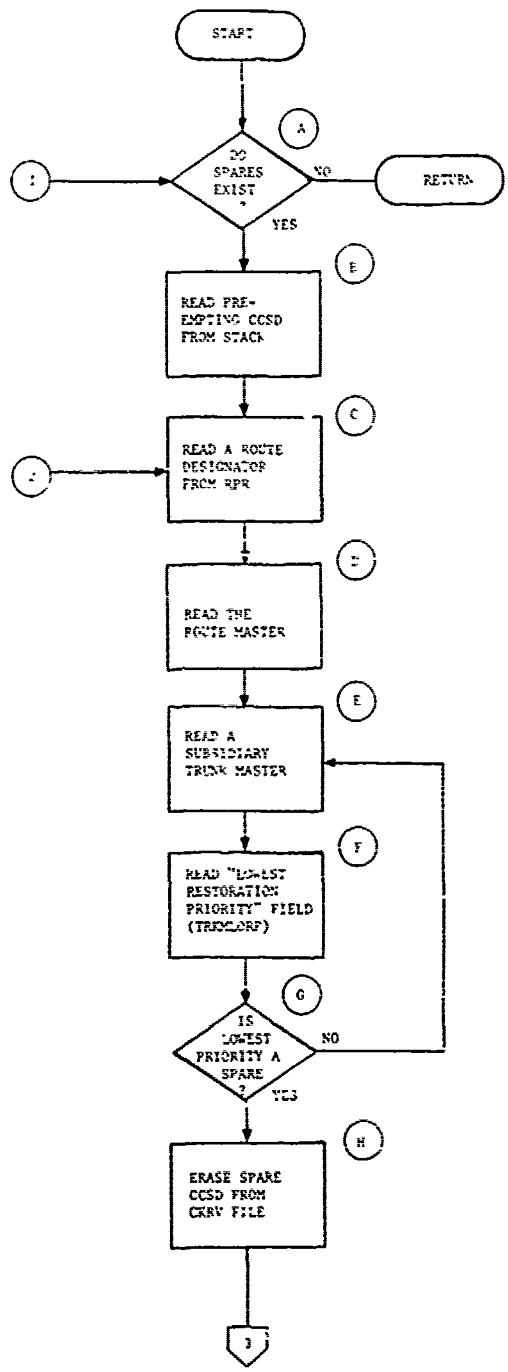


Figure 2-13. Subroutine 4.3 - Preempt Spares (sheet 1 of 2)

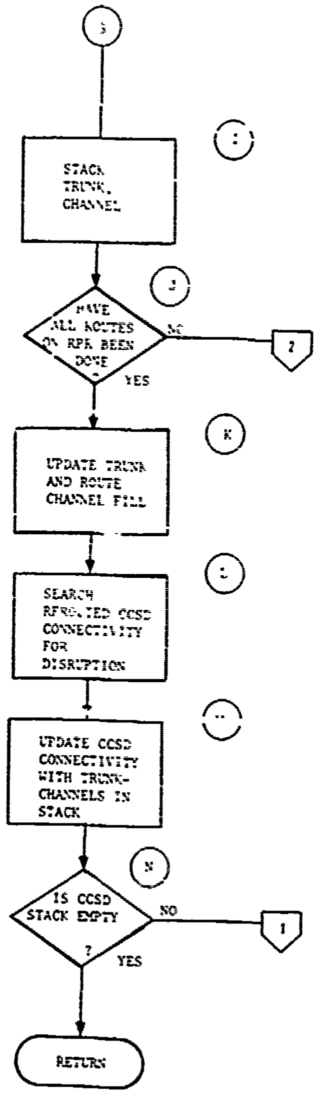


Figure 2-13. Subroutine 4.3 - Preempt Spares (sheet 2 of 2)

(M) CCSD connectivity is updated with trunk-channels in stack. In other words, the disrupted connectivity is replaced with the reroute path.

(N) If the CCSD stack is empty, control is returned to the calling program.

2.14 Subroutine 5.0 - Estimate Restoral Times

Referring to Figure 2-14, this procedure computes an estimated restoral time for each circuit rerouted. This estimate is based on ACOC effectiveness, reroute path length, technical control orderwire connectivity and technical control workload.

(A) A theater is selected. This procedure is performed on one theater at a time, since each theater has its own ACOC effectiveness, connectivity matrix and RPR file.

(B) ACOC effectiveness is computed.

(C) Circuit restoral times are assigned.

(D) After all theaters have been completed, control is returned to to the calling program.

2.15 Subroutine 5.1 - Determine ACOC Effectiveness

Referring to Figure 2-15, this procedure is used to estimate the effectiveness of the ACOC in providing assistance to the technical control facilities which are involved in reroute activity.

(A) Station work status is checked. This procedure is used to determine which tech control facilities are involved in reroute activity.

(B) Working station reporting status is determined. This procedure determines whether communications circuits exist between the TCF reporting stations and the ACOC. These circuits are used to report status to the ACOC and receive direction from the ACOC. The availability of such circuits

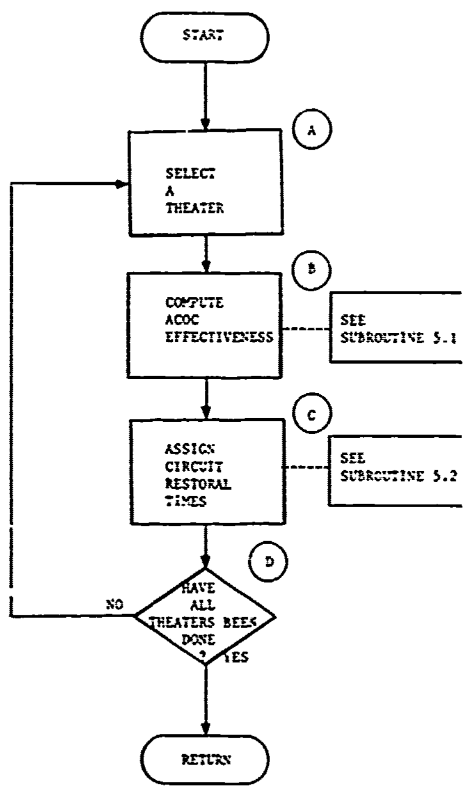


Figure 2-14. Subroutine 5.0 - Estimate Restoral Times

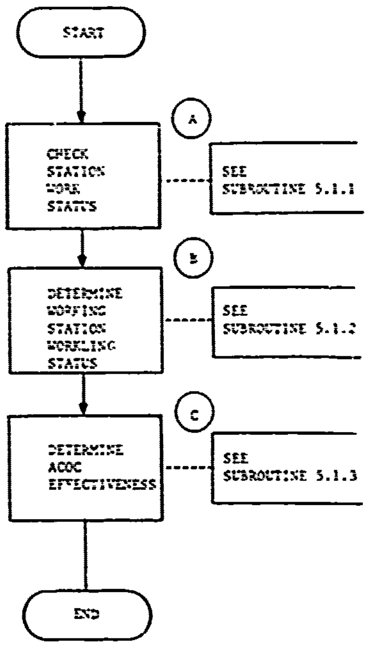


Figure 2-15. Subroutine 5.1 - Determine ACOC Effectiveness

determines the effectiveness of the ACOC in performing its function.

(C) ACOC effectiveness is computed. There are three levels of ACOC effectiveness, 0%, 50% and 100%. The level of ACOC effectiveness is a factor considered when estimating restoral times.

2.16 Subroutine 5.1.1 - Check Station Work Status

Referring to Figure 2-16, this procedure determines which stations are involved in reroute activity. This information is necessary to compute ACOC effectiveness since, in general, only those stations which are rerouting are interacting with the ACOC. This is accomplished by examining the end station on the reroute path records (RPRs) and compiling a list of these stations. The TCF reporting stations are then checked to see if they appear on the list.

(A) The RPR file is called.

(B) An RPR record is read.

(C) The first disruption end point is read.

(D) The list of stations thus far compiled is checked to see if the station is already listed. This list of stations is called the "working station list".

(E) The station is added to the working station list.

(F) The second disruption end point is read.

(G) & (H) Same as D & E

(I) If all RPRs have been checked, (J) the RPR file is returned.

(K) REPORTING STATION CONNECTIVITY Matrix is called.

A station name is read from matrix. The station name is the key for each record in the matrix.

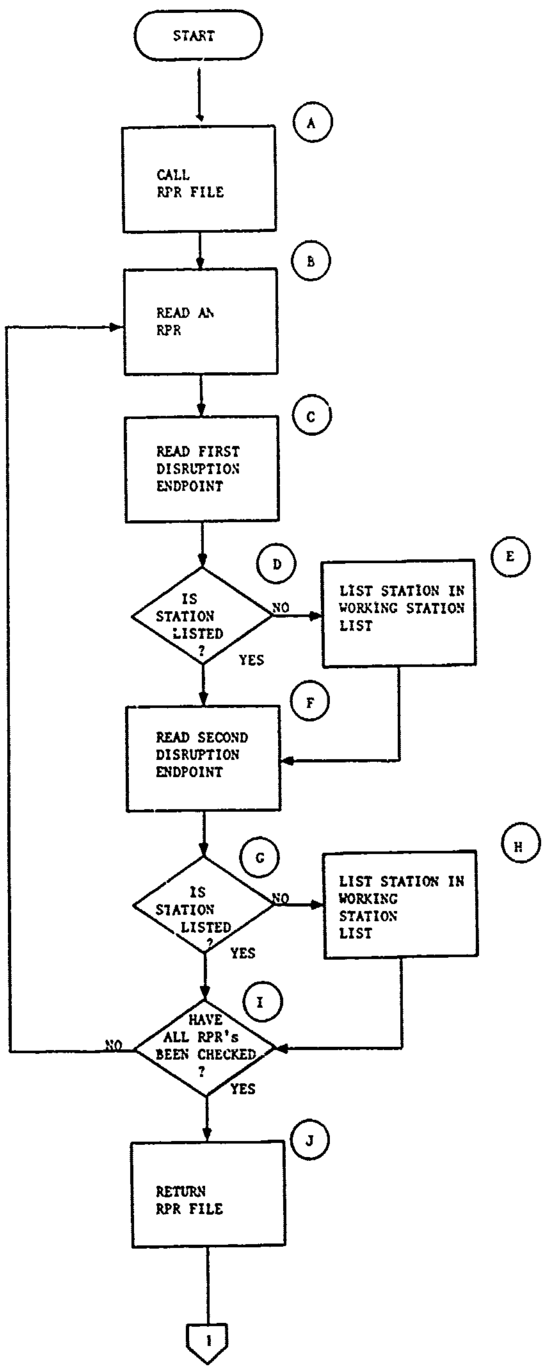


Figure 2-16. Subroutine 5.1.1 - Check Station Work Status (sheet 1 of 2)

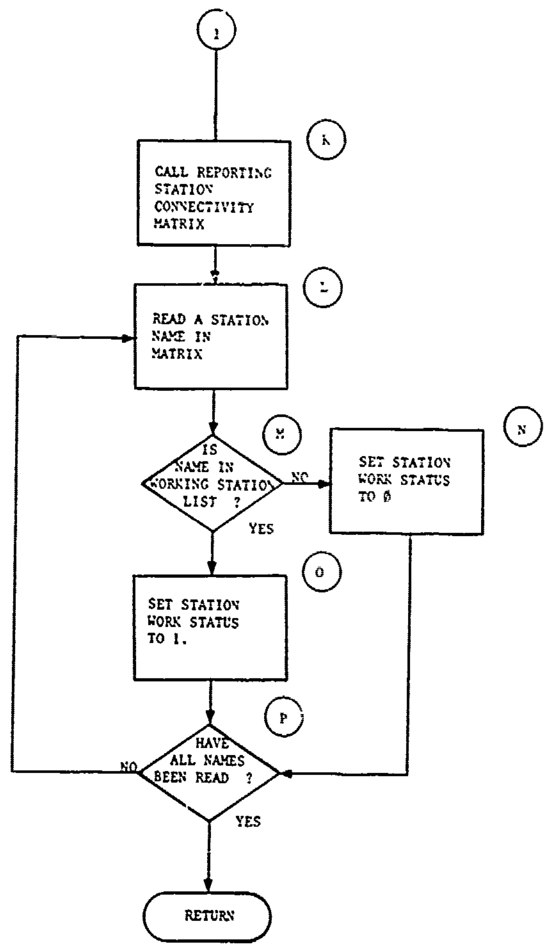


Figure 2-16. Subroutine 5.1.1 - Check Station Work Status (sheet 2 of 2)

(M) Is name in working station list? If the station name is in the working station list, then (O) the station work status is set to 1. If it isn't then (N) the station work status is set to 0.

(P) After all the records in the matrix have been read, control is returned to the calling program.

2.17 Subroutine 5.1.2 - Determine Station Reporting Status

Referring to Figure 2-17, the purpose of this procedure is to determine which working stations have connectivity with the ACOC when reroute activity is being performed.

(A) The ACOC-AUTODIN connectivity record is read. This record lists all the ACOC AUTODIN access lines and thus reflects the ability of the ACOC to access the AUTODIN network.

(B) DCON is an acronym for AUTODIN connectivity time. That is, the time at which the ACOC has connectivity with the AUTODIN network. This time is initialized to 9999. In other words, 9999 indicates that at this time it is assumed that connectivity will not exist until the scenario is over.

(C) CCSD in time is read. That is, the in time for the first CCSD in the record is read.

(D) In time $<$ DCON? If in time for the CCSD is not less than the DCON time, then (C) the next CCSD in time is read if (F) all the in times have not been checked. What this does is pick the earliest time at which ACOC-AUTODIN connectivity existed.

(E) . DCON$\leftarrow$In Time. If the CCSD in time is less than the DCON time, then the CCSD in time becomes the new DCON time.

(F) Have all in times been checked? If all the AUTODIN CCSD in times have been checked then the same thing is done for the AUTOVON access lines.

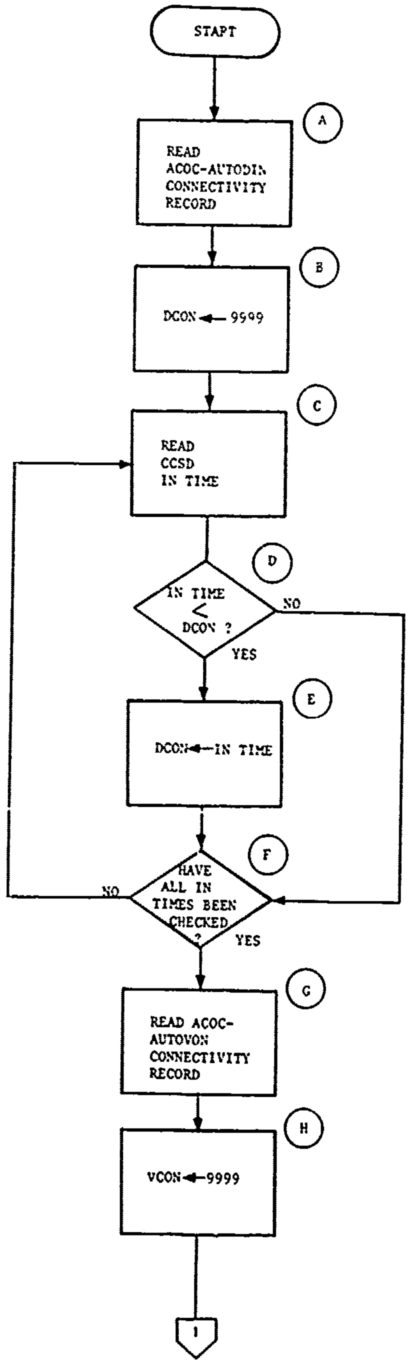


Figure 2-17. Subroutine 5.1.2 - Determine Station Reporting Status (sheet 1 of 4)

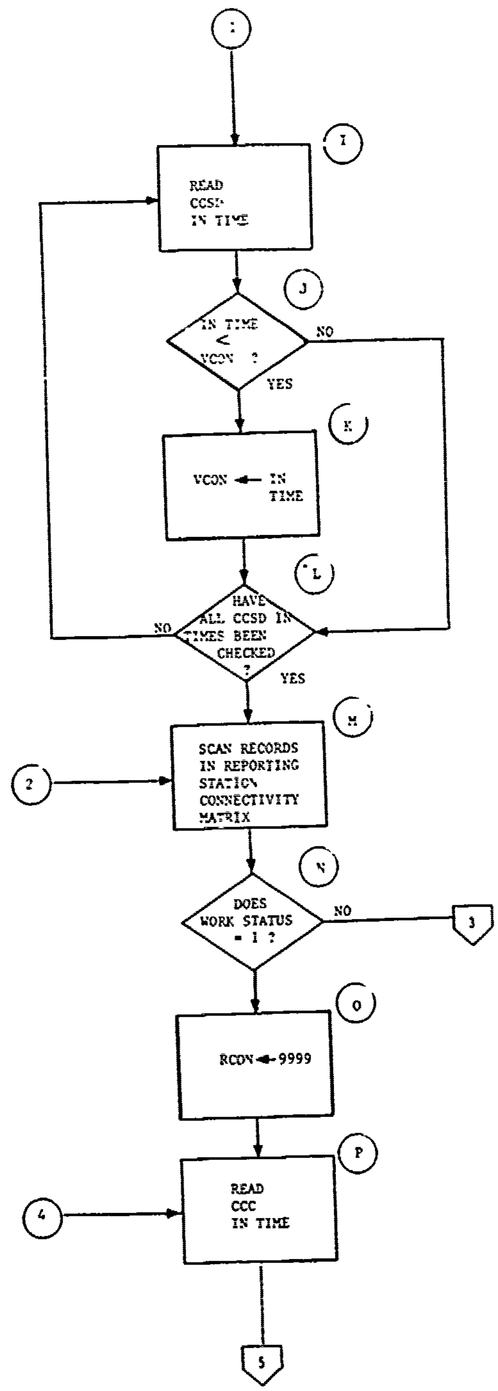


Figure 2-17. Subroutine 5.1.2 - Determine Station Reporting Status
(sheet 2 of 4)

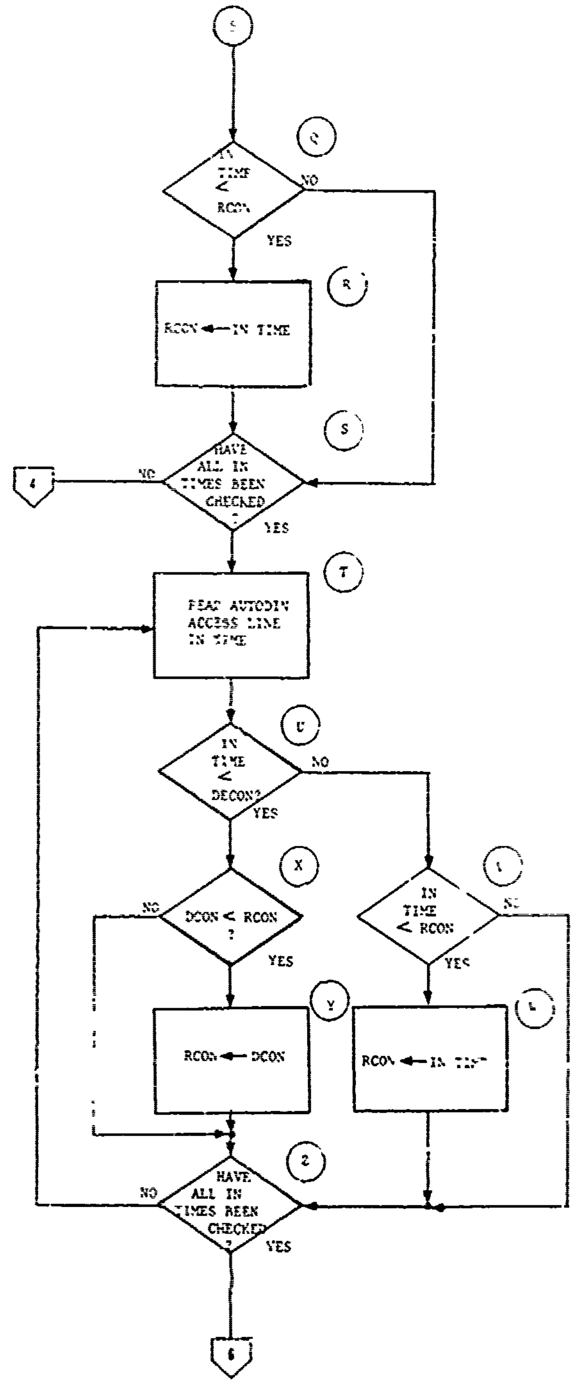


Figure 2-27. Subroutine 5.1.2 - Determine Station Reporting Status (sheet 3 of 4)

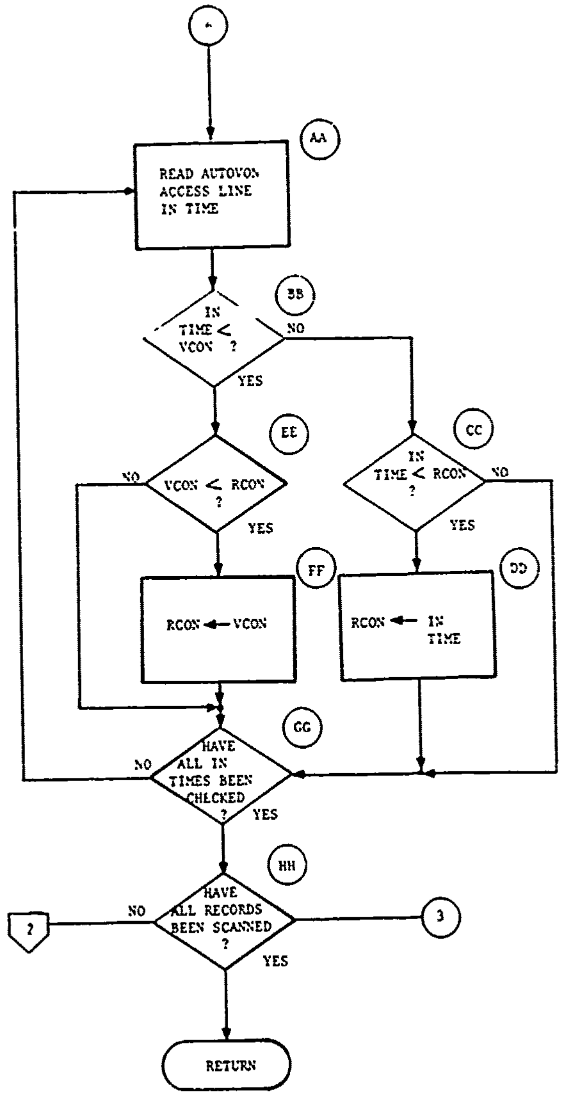


Figure 2-17. Subroutine 5.1.2 - Determine Station Reporting Status (sheet 4 of 4)

(G) An ACOC-AUTOVON CONNECTIVITY record is read.

(H) VCON←9999. VCON is an acronym for AUTOVON CONNECTIVITY. It is initialized to 9999.

(I) Read CCSD in time. Same as (C)

(J) In Time < VCON. Same as (D)

(K) VCON←IN Time. Same as (E)

(L) Have all in time been checked? Same as (F)

(M) The records in REPORTING STATION CONNECTIVITY matrix are scanned to identify those reporting stations which are involved in reroute activity.

(N) If the work status is not equal to 1, then it doesn't matter if the station has connectivity or not, since it will not be counted when computing ACOC effectiveness.

(O) RCON←9999. RCON is an acronym for reporting station connectivity time. It is initialized to 9999.

(P) A CCC in time is read.

(Q) In TIME < RCON. If the in time is not less than the RCON, the program (S) takes a look at the next in time.

(R) RCON←In time. If the in time is less than the RCON time, then the in time becomes the new RCON. This establishes the earliest time at which CCC connectivity exists between the TCF and ACOC.

(S) If all the CCC in times have been checked, then the program goes on to check the connectivity via the AUTODIN network.

(T) AUTODIN ACCESS LINE in time is read. This would be the in time for one of the AUTODIN access lines in the second section of the REPORTING STATION CONNECTIVITY matrix.

U In Time < DCON. If the in time was less than the DCON time, then DCON time is used since both the TCF and the ACOC need connectivity to the AUTODIN Network before it can be used for communicating. The program thus proceeds to X .

V In Time < RCON.

W In Time ← RCON. If the in time is less than the RCON time then the in time becomes in the new RCON time.

X DCON < RCON.

Y DCON ← RCON. If the DCON is less than the RCON time, then the DCON time becomes the new RCON time.

Z If all AUTOVON access line in times have been checked then the next step is to check the connectivity via the AUTOVON network.

AA thru GG These blocks perform the same checks on AUTOVON lines as the corresponding blocks in T through Z do for the AUTODIN lines.

HH If every working station has been checked, then control is returned to the calling program.

2.18 Subroutine 5.1.3 - Compute Effectiveness

Referring to Figure 2-18, after the working stations have been identified and the connectivity status of these stations determined, this procedure calculates the actual ACOC effectiveness. The ACOC effectiveness is a function of TCF-ACOC connectivity. For connectivity 0<C<25%, ACOC effectiveness is considered to be 0%. For TCF-ACOC connectivity 25≤C≤75%, ACOC effectiveness is 50%, and for TCF-ACOC connectivity 75<C<100%, ACOC effectiveness is considered to be 100%.

A STCOUNT and RLCOUNT are acronyms for working stations count and reporting line count. These counters keep track of the

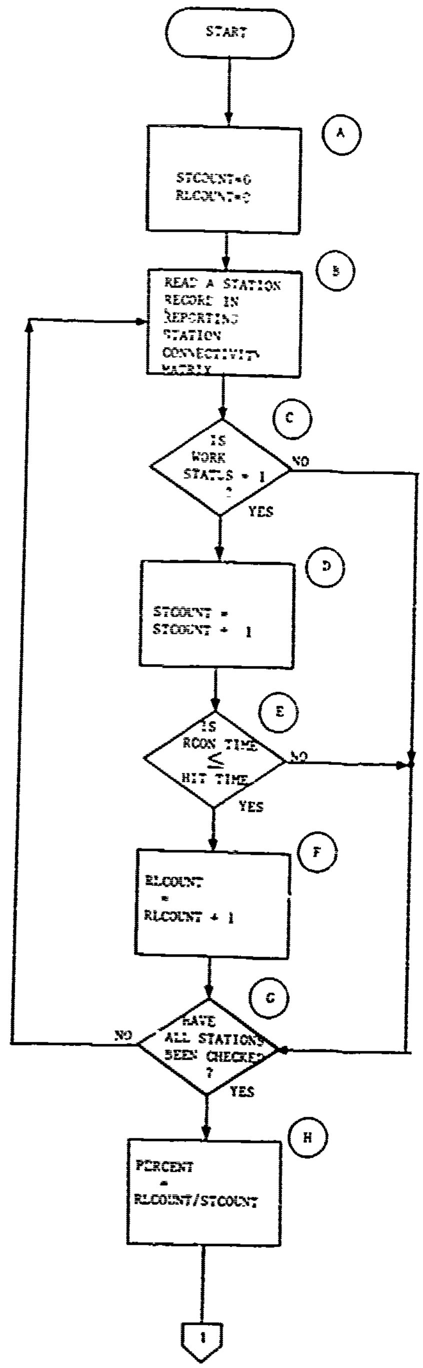


Figure 2-18. Subroutine 5.1.3 - Compute Effectiveness (sheet 1 of 2)

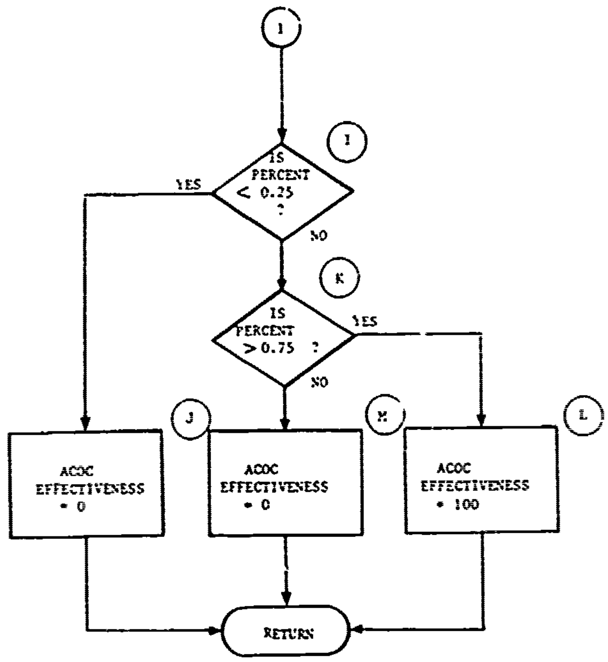


Figure 2-18. Subroutine 5.1.3 - Compute Effectiveness (sheet 2 of 2)

total number of TCF's involved in reroute activity (STCOUNT) and the number of these TCF's (RLCOUNT) which can communicate with the ACOC. The counters are initialized to zero.

B A station record in the reporting station connectivity matix is read.

C If the work status is not equal to 1, then this station is not counted.

D The count of working stations is incremented.

E Is RCON time $\leq$ hit time.
If RCON is not equal to or less than the time of the next disruption then this station cannot communicate with the ACOC.

F The count of TCF's which have ACOC connectivity is incremented.

G Have all stations been checked.

H Percent $\leftarrow$ RLCOUNT/STCOUNT
Percent is the fraction of working TCF's which have ACOC connectivity.

I thru M Self explanatory.

2.19 Subroutine 5.2 - Assign Restoral Times

Referring to Figure 2-19, after all reroute paths have been found and stored in the reroute path records, this procedure computes restoration times for each circuit. In order to do this, it is necessary to keep track of reroute activity time in each tech control facility. To accomplish this, it is assumed that a tech controller is available at each end of a route and can devote full time attention to that route. Each tech controller's time is then accounted for in the working time logs in the route master record. There are two such logs in each route master. One for the tech controllers at each end of the route. The first log is for the controller at the first end and the second is for the controller at the second end.

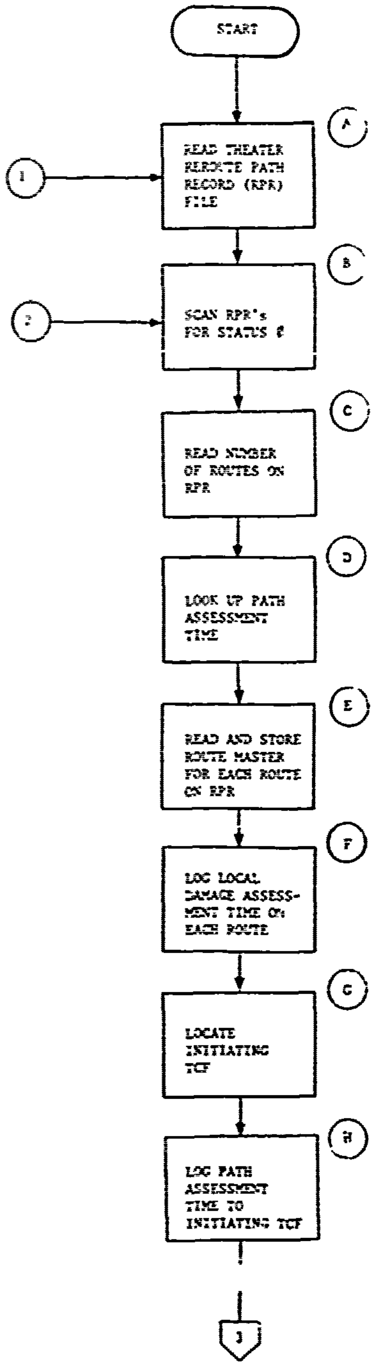


Figure 2-19. Subroutine 5.2 - Assign Restoral Times (sheet 1 of 3)

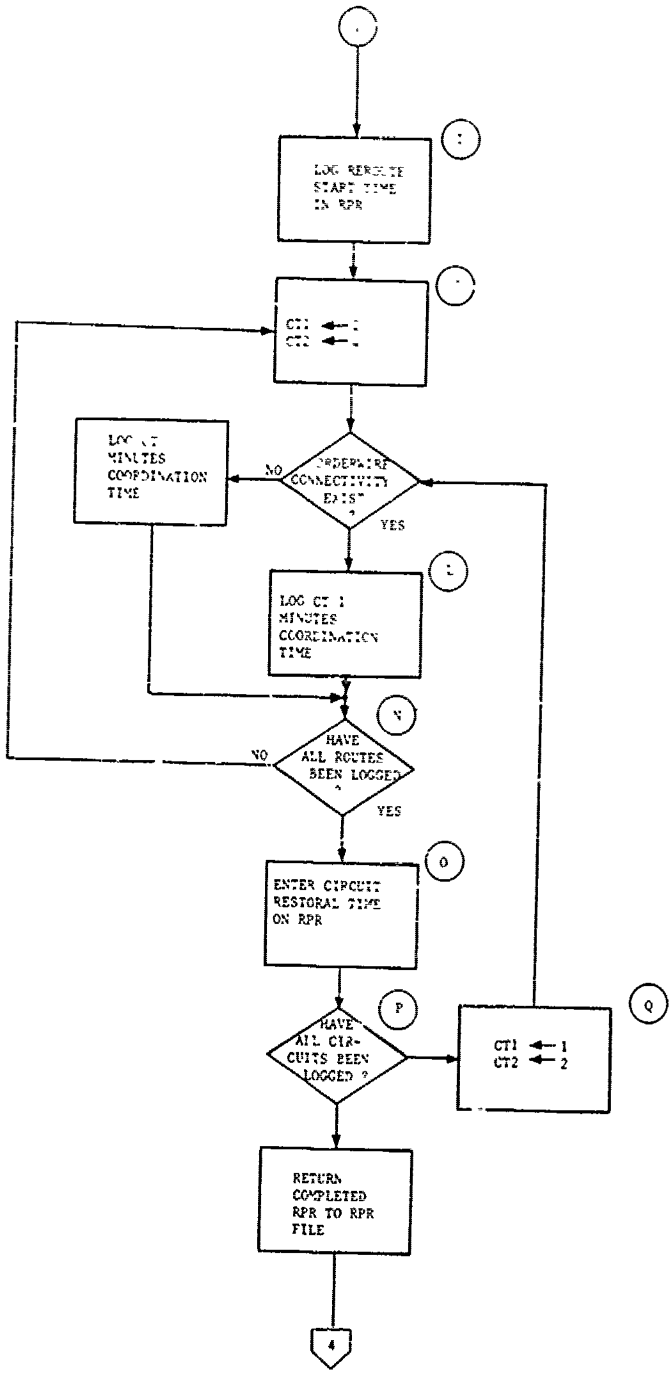


Figure 2-19. Subroutine 5.2 - Assign Restoral Times (sheet 2 of 3)

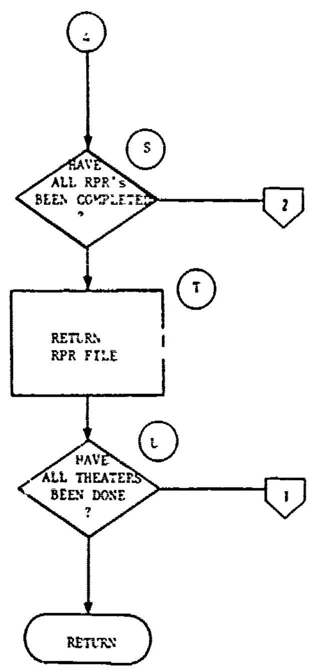


Figure 2-19. Subroutine 5.2 - Assign Restoral Times (sheet 3 of 3)

(A) The theater reroute path record (RPR) file is read.

(B) The RPRs are scanned for those with status = 0.

(C) The number of routes on the RPR is read. This number is entered in the record when the reroute path is found. It is used when looking up path assessment time (PAT) in the PAT table.

(D) Path assessment time is looked up. PAT is a function of both reroute path length and ACOC effectiveness. ACOC effectiveness was computed in the previous procedure.

PAT TABLE

Reroute path length	25	50	75 ←ACOC effectiveness
1	0	0	0
2	3	1	1
3	5	3	2
4	7	5	2
5	9	6	3
6	11	7	3

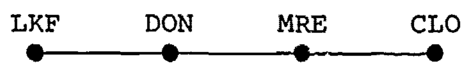
(E) The ROUTE MASTER record is read and saved for each route on the RPR. All that is needed from the route master record at this point is the working time logs, the hour counters and the orderwire connectivity flag.

(F) Local damage assessment time is logged on each route. Local damage assessment time is the time of the disruption plus the following four minutes.

NOTE ON LOGGING: The attack scenarios can span a period of up to 24 hours. To cover the full twenty four hours in the working time log would require 1440 bytes for each route. In order to reduce the record size and at the same time accomplish the task, a working time log of 3 hours and an elapsed hour counter are used. Each minute in the working time log requires one byte. When the 3 hours in the working time log have been filled, all the entries are shifted 60 minutes to the left and the elapsed hour counter is incremented by one. Therefore, before any times are logged, it is necessary to check which 3 hour slot (out of 24 hours) is occupied by the working time log.

(G) The initiating TCF is identified. Reroute action for a circuit or group of circuits over a particular path is normally initiated by one or the other tech controllers at the end points of the reroute path. It is assumed that either could initiate the reroute, and that the one who can do it first will. Therefore, to determine which tech controller gets logged with path assessment time it is necessary to look at the working time logs for the two end terminal TCF's and see which one has the first idle period equal tc the path assessment time. This is done by beginning at the next minute following the local damage assessment time and counting idle minutes (blanks or zeroes) until the number equals the path assessment time and noting the time which this occurs. The tech control with the earliest such time will be the initiating TCF.

(H) Path assessment time is logged to the initiating tech control. NOTE: It should be pointed out at this time that working time logs for end terminals TCF's can be either the first or second one in a route master record depending on the direction of the reroute path, or the sequence in which the routes were found. The following is an example of various possibilities.



Reroute path = DONLKF01, CLOMRE01
= CLOMRE01, DONMRE01

Route	CLOMRE01	DONMRE01	DONLKF01
WTL's	CLO MRE	DON CLO	CLO LKF

Route	DONLKF01	DONMRE01	CLOMRE01
WTL's	DON LKF	DON CLO	CLO MRE

The end terminal working time logs (WTL) were circled in each case. As one may observe, there is no consistency in where the end terminal working time logs will be located. However, the end terminals of the reroute paths are listed in the RPR and they can be used to locate the end terminal working time logs.

(I) The reroute start time is logged in the RPR. The reroute start time is the first minute of the path assessment time. This time is entered in the space reserved for it in the RPR.

(J) CT1 ← 2, CT2 ← 4

CT1 and CT2 are coordination and patching times. For the first circuit on an RPR, 2 and 4 minutes are used. For subsequent reroutes on the same RPR, 1 and 2 minutes are used. CT1 is coordination time used when orderwire connectivity exists between the TCF's at two ends of a route. CT2 is the time used when orderwire connectivity does not exist.

(K) The orderwire connectivity flag is examined to determine if orderwire connectivity exists for the route. A "1" indicates no connectivity and a "0" indicates connectivity.

(L) & (M) If orderwires exist, CTI minutes is logged on that route. If orderwires do not exist, CT2 minutes is logged. When logging CT, logging begins at the initiating tech control route and works towards the other end. The fact that the tech controller at both ends of a route work together in patching up the circuit is accounted for when logging CT. If one tech controller is busy working on another task, the other tech controller must wait. Therefore, it is necessary to check both working time logs to find the next available CT minutes in which both are idle (blanks or zeroes) and CT minutes is logged to both tech controls (both working time logs).

(N) & (O) If CT has been logged on all the routes of the reroute path then restoral time is entered for that circuit in the RPR. The restoral time is the time that the final minute was logged on the final route.

(P) & (R) If all the circuits on the RPR have been logged then the RPR is returned to the RPR file after setting the status to 1. Status one at this point simply indicates that the RPR has been logged.

(S) & (T) If restoral times have been computed on all the RPR's then the RPR file is returned to disc.

(U) If all theaters have been completed, then control is returned to the calling program.

2.20 Subroutine 6.0 - Update CCSD Records

Referring to Figure 2-20, this procedure updates the CCSD master records to reflect circuit restoral time and change in connectivity due to the reroute path.

(A) A theater RPR file is read.

(B) An RPR from the file is read

(C) If the RPR status is equal to 9, then a reroute path was found.

(D) A CCSD is read from the RPR.

(E) The CCSD Master Record is read.

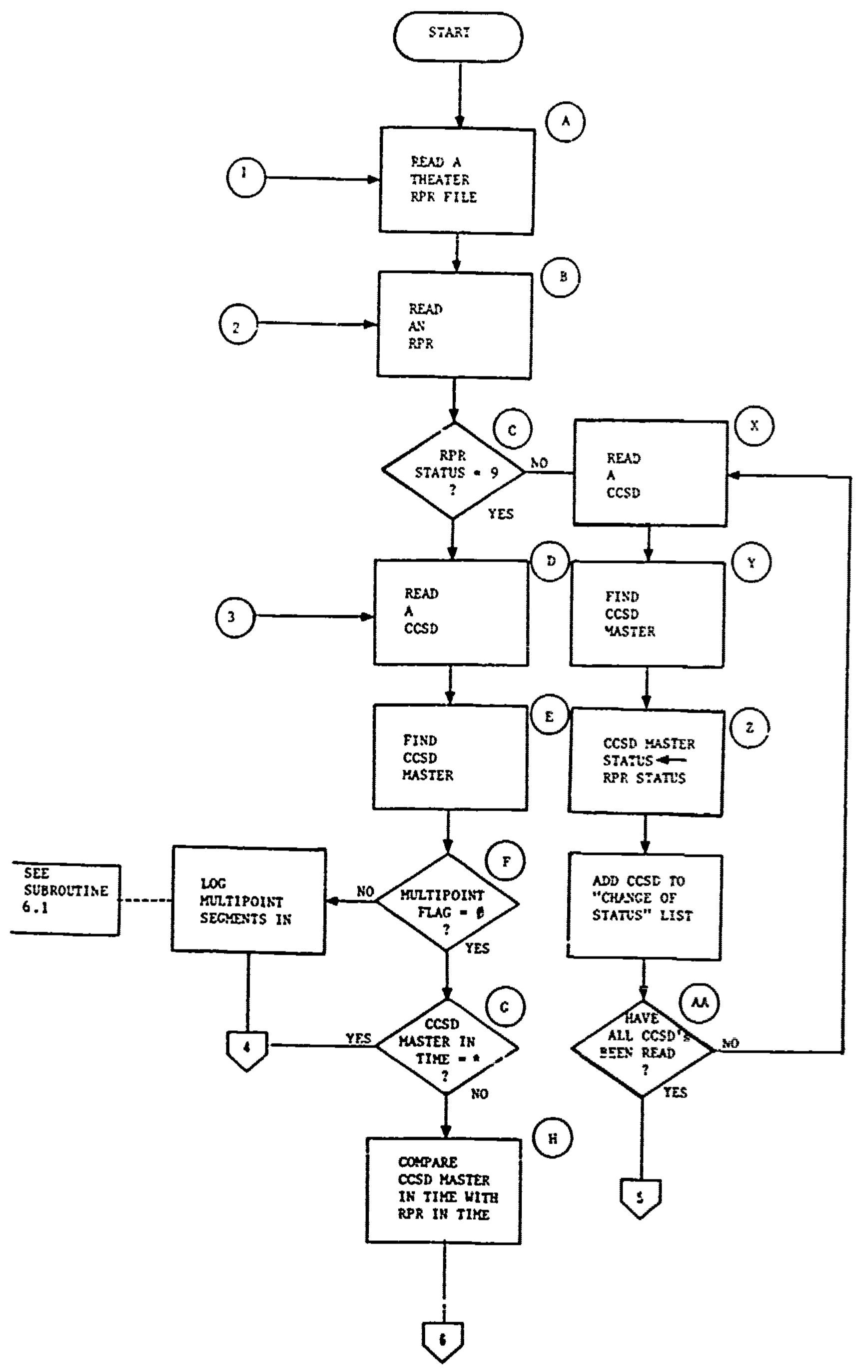


Figure 2-20. Subroutine 6.0 - Update CCSD Records (sheet 1 of 3)

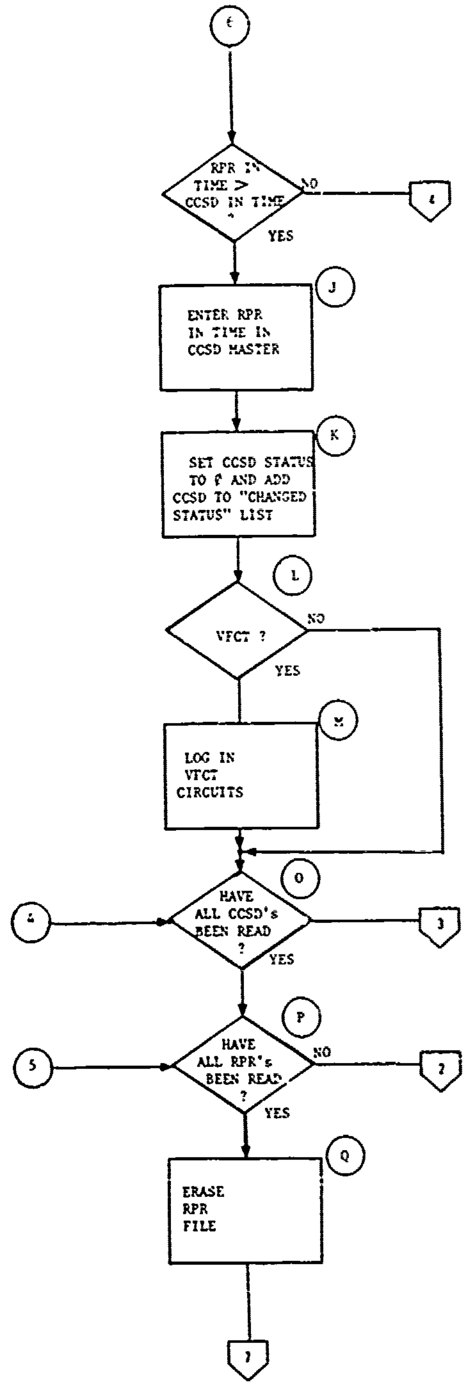


Figure 2-20. Subroutine 6.0 - Update CCSD Records (sheet 2 of 3)

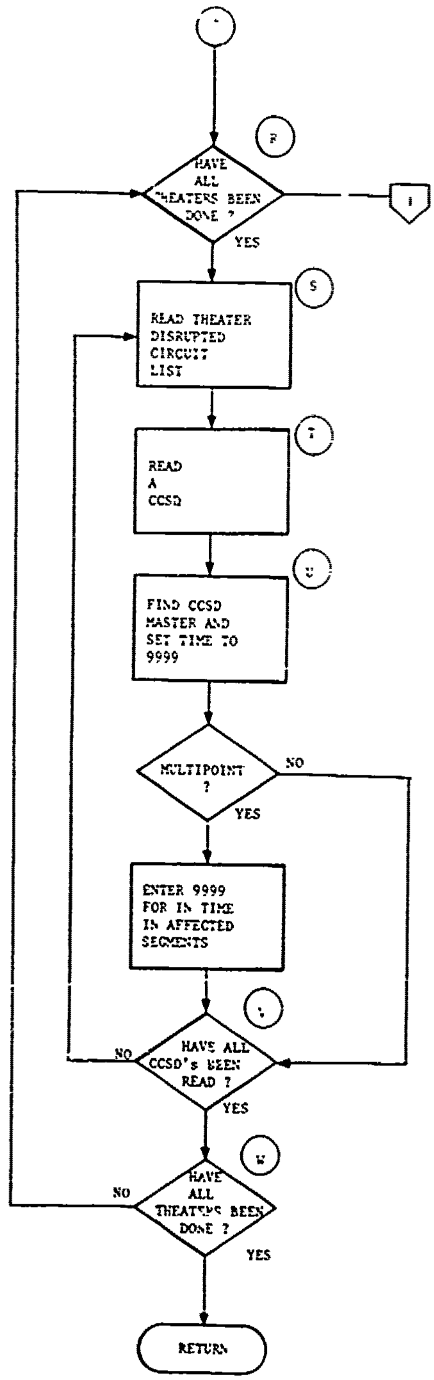


Figure 2-20. Subroutine 6.0 - Update CCSD Records (sheet 3 of 3)

(F) If the multipoint flag is not equal to zero, then the circuit is multipoint and a separate procedure is used.

(G) If the in time in the CCSD master record is equal to "*", then another disruption exists on the circuit for which no reroute path could be found. Therefore, the circuit cannot be logged in.

(H) The CCSD Master in time is compared with the RPR in time.

(I) If the RPR in time is not greater than the CCSD in time, then the in time which is currently entered in the CCSD Master is used. This situation occurs when a circuit is disrupted at two separate locations. The latest in time is used, since the circuit will not be restored until all reroutes are up.

(J) If RPR in time is greater, then it is entered into the CCSD master.

(K) Also the CCSD status is set to 0, operational.

(L) If it's a VFCT, (M) the teletype circuits riding it must be logged in.

(O) If all CCSD's have been read, the procedure is repeated for the next RPR.

(P) If all RPR's have been read, (Q) the RPR file is erased and the procedure is repeated for the next theater.

(R) After all the theaters are finished, all the asterisk (*'s) from the CCSD in times that were inserted earlier must be removed. They are not wanted during the next pass through the restoral algorithm.

(S) The theater disrupted circuits list is read.

(T) A CCSD is read and (U) the CCSD Master is read and the in time set to 9999.

(V) & (W) After all CCSD's in all theaters have been read, control is returned to the calling program.

(X) If the status is not 9, a CCSD is read, (Y) the CCSD master is found and (Z) the CCSD Master status set to the value of RPR status.

2.21 Subroutine 6.1 - Log Multipoint Segments

Referring to Figure 2-21, this procedure is used to log in the segments of a multipoint circuit.

(A) A segment CCSD Master record is read.

(B) If the segment status is not 1 or 0, then there is a reason why the circuit cannot be restored and it is not logged in. The status may be 0, operational, because it may have already been restored at another break in this segment and the status changed from 1 to 0.

(C) Segment CCSD connectivity is examined to see if it's an affected segment. Some segments may be affected by a disruption, while other segments are not. It must be determined if this segment is affected by this particular disruption.

(D) The symbol "*" is used to indicate that a reroute was attempted on this disruption but the reroute path was disrupted again before it could be completed. Therefore, if there are other reroutes on this segment, the circuit is not logged in.

(E) Is segment in time = 9999. If it is, the program proceeds to (H) and enters RPR in time in the segment CCSD master record.

(F) The segment CCSD in time is compared to the RPR in time.

(G) & (H) If the RPR in time is greater than the CCSD in time then the RPR in time becomes the new CCSD in time, since the segment is not restored until all reroutes are up and the restoral time will be the time that the last reroute was put up.

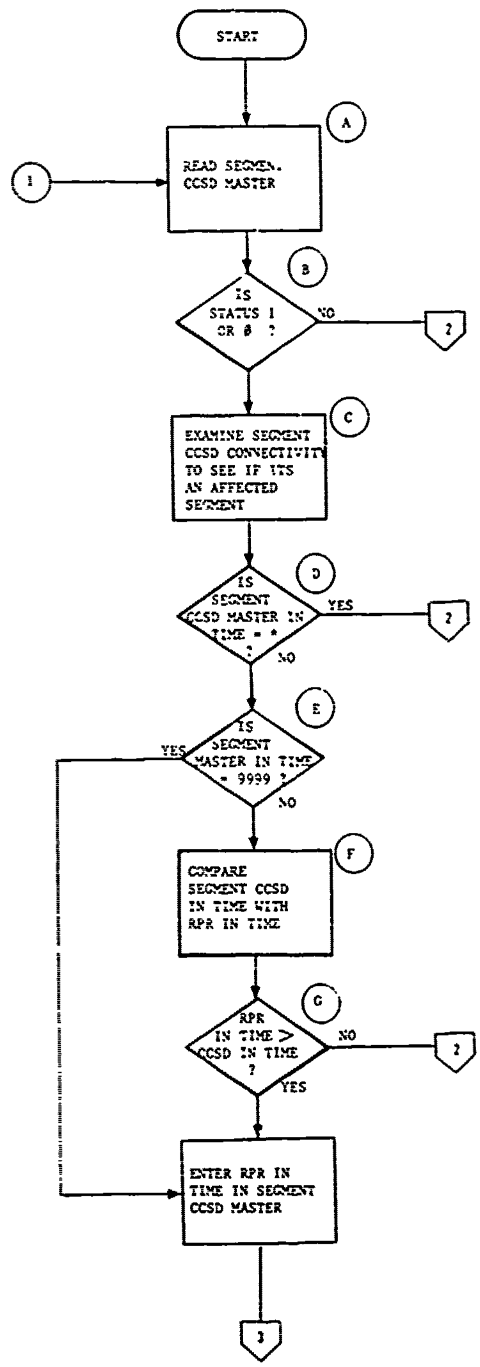


Figure 2-21. Subroutine 6.1 - Log Multipoint Segments In (sheet 1 of 2)

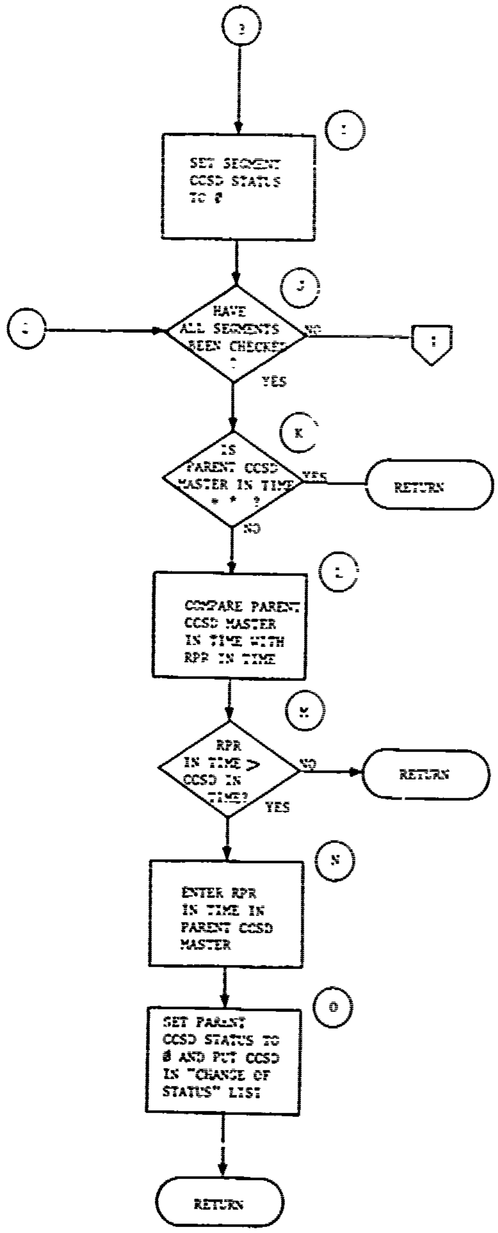


Figure 2-21. Subroutine 6.1 - Log Multipoint Segments In
(sheet 2 of 2)

(I) The segment CCSD status is set to 0.

(J) If all the segments have been checked, the parent CCSD Master is updated.

(K) through (O) Same as above.

SECTION 3 - CRAM DATA BASE

This section contains a description of the CRAM data base schema and content and a description of the data base build process.

3.1 Data Base Schema

Figure 3-1 is a schematic representation of the CRAM data base utilizing the TOTAL Data Base Management System. The CRAM data base is divided into two sections, the connectivity section and the restoral section. The connectivity section contains all static DCS connectivity related information; whereas the restoral section contains working files, the contents of which will be manipulated during the execution of the algorithm. The following is a list of files together with a brief discussion of the use of each file. A table is also provided for each file which details the data sets and the file structure.

AALM - ACOC Access Line Master File

The ACOC Access Line Master File contains descriptive information about each circuit as well as a path to the ACOC Access Line Variable file. By interaction with this file, the theater and reporting station to which the circuit is connected can be obtained. AALM data sets and file structure are detailed in Table 3-1.

ATCM - ACOC Theater Connectivicy Master File

The ACOC Theater Connectivity Master File contains the list of all the reporting stations in the DCS. The ACOC Theater Connectivity Master file interacts with the ACOC Access Line Variable file to obtain all the access lines to the reporting station. ATCM data sets and file structure are detailed in Table 3-2.

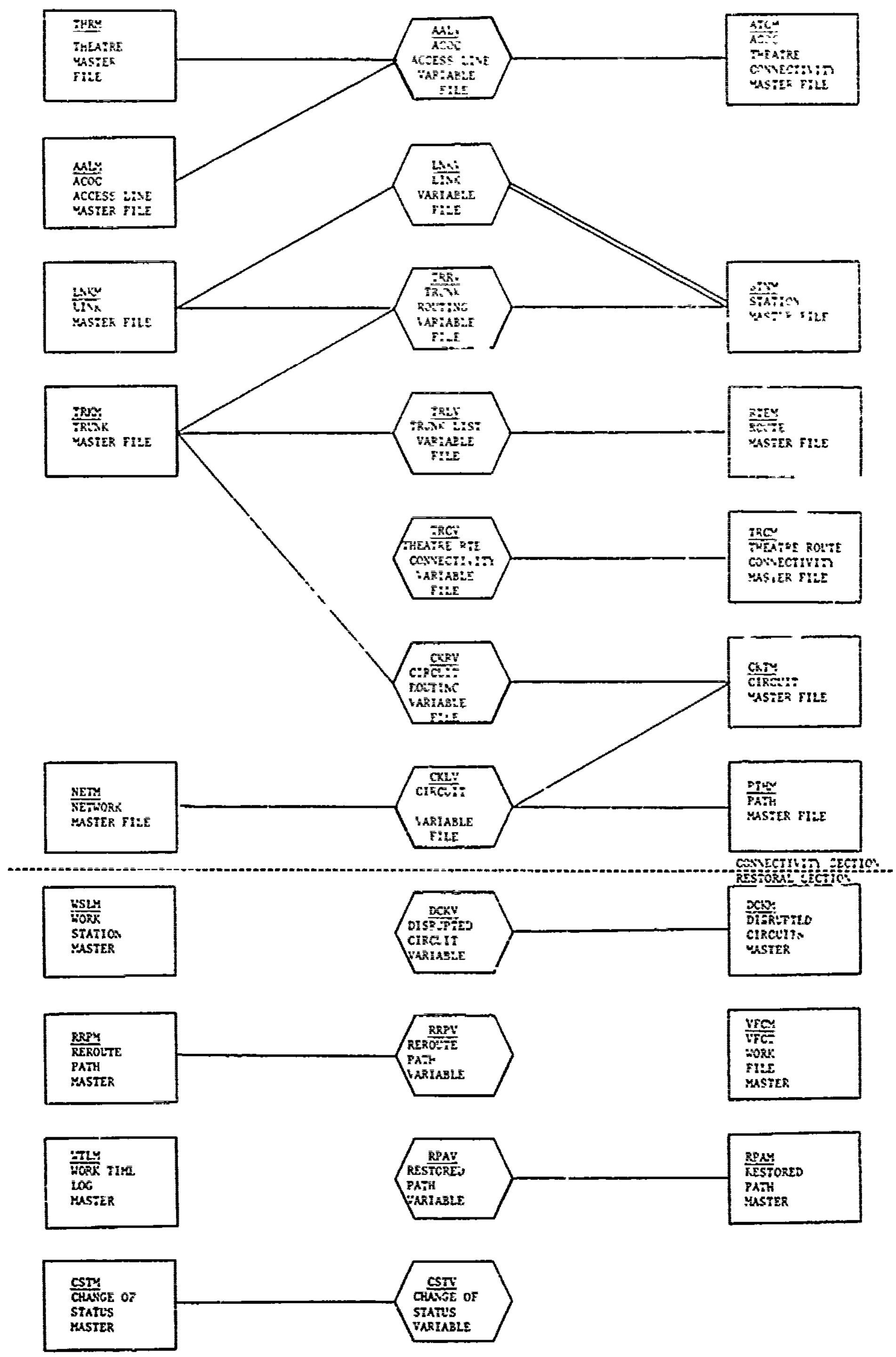


Figure 3-1. CRAM Data Base Schema

Table 3-1. AALM-ACOC Access Line Master File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
AALMROOT	Root Field. This field is maintained by the DBMS and is used as a synonym pointer.	8	
*AALMCTRL	CCSD Number. This field is the record control key and defines the key element for the record. The field contains the eight character CCSD number of the access lines to either the ACOC or a reporting station.	8	DDDA9SLN
AALMLKAA	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the ACOC access line variable file (AALV).	8	
	*Key Element		

Table 3-2 ATCM-ACOC Theater Connectivity Master File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
ATCMROOT	Root Field. This field is maintained by the DBMS and is used as a synonym pointer.	8	
*ATCMCTRL	Reporting Station Name. This field is the record control key and defines the key element value for the record. The station code will contain an 8 character station name, a 3 character facility code, a 2 character country code, and a 1 character area code.	14	LANGRKPFTCFGE4
ATCMLKAA	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the ACOC access line variable file (AALV).	8	
ACTMACOC	ACOC Flag. This field indicates is this station in the ACOC. 0 = Not ACOC 1 = ACOC	1	0
ACTMWKST	Station Work Status. 0 = Not working on a reroute path 1 = Working on a reroute path	1	0
ATCMRCON	Reporting Station Connectivity Time. This field contains the earliest time (in elapsed minutes from the scenario start) that the station could report to the ACOC.	4	0030
ATCMVCON	AUTOVON Connectivity Time. This field contains the earliest time (in elapsed minutes from scenario start) that the station could report to the ACOC through AUTOVON.	4	0090
ATCMDCON	AUTODIN Connectivity Time. This field contains the earliest time (in elapsed minutes from scenario start) that the station could report to the ACOC through AUTODIN.	4	0030
	*Key Element		

CKTM - Circuit Master File

The Circuit Master File contains descriptive information about each circuit as well as a path to the Circuit List (CKLV) and the Circuit Routing (CKRV) variable files. By interaction with these two files, the network, path and trunks related to a given circuit can be found. CKTM data sets and file structure are detailed in Table 3-3.

CSTM - Change of Status Master

The Change of Status Master File will contain the CCSD numbers for circuits that have changed status during the scenario. This file will also contain the list of trunk/channels that change status because of preemption during the scenario. CSTM data sets and file structure are detailed in Table 3-4.

DCKM - Disrupted Circuits Master File

The Disrupted Circuits Master File contains the records of the CCSDs that have been disrupted by the scenario. The Disrupted Circuits Master File is directly linked to the Disrupted Circuits Variable file. Interaction with the file will tell the user where the endpoints of a disruption(s) is. DCKM data sets and file structure are detailed in Table 3.5.

LNKM - Link Master File

The Link Master File contains information describing a link between two stations. The Link Master File is associated with two variable files, the Trunk Routing (TRRV) and the Link (LNKV) variable files.

The Link Master File supplies descriptive information about the links listed in the TRRV and the LNKV files. LNKM data sets and file structure are detailed in Table 3-6.

Table 3-3. CKTM-Circuit Master File(sheet 1 of 3)

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
CKTMROOT	Root Field. This field is maintained by the DBMS and used as a synonym pointer.	9	
*CKTMCTRL	Circuit Number. This field is the record control key and defines the key element for the record.	8	DUUC9HMS
CKTMLKCR	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the circuit routing variable file (CRRV).	8	
CKTMLKCL	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the circuit list variable file (CRLV).	8	
CKTMDATA	Circuit Data Field. This field is subdivided into the 14 subelements which follow this description.	66	
CKTMREST	Restoration Priority.	2	1A
CKTMCLAS	Mission critical flag where a "C" will indicate that a circuit is a mission critical circuit, otherwise the item will be blank.	1	C
CKTMAVAL	Circuit Availability Code	1	H
CKTMVFCT	VFCT Trunk Number. If not applicable, it will be filled with blanks.	6	44UX02
CKTMMODR	Circuit modulation rate	2	0G
CKTMSIGL	Mode of signaling	1	D
	*Key Element		

Table 3-3. CKTM-Circuit Master File (sheet 2 of 3)

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
CKTMDTGI	Time Circuit Back In Service. Two characters each to indicate year, month, day, hours, and minutes.	10	7811090530
CKTMDTGO	Time Circuit Out of Service. This field is identical to CKTMDTGI.	10	7811090530
CKTMSTAT	Circuit Status where 0 = Operational 1 = Disrupted but restorable 2 = Not restorable due to disrupted end terminal 3 = No reroute attempted because not in area of study 4 = No reroute path available 5 = TTY circuit - no reroute action at DC level 6 = Not restorable due to low restoration priority 7 = Circuit preempted by higher priority circuit 8 = Disrupted and restorable, but preempted by higher priority circuit.	1	7
CKTMEND1	Ending Station of Circuit. The station ID will consist of an 8 character station code, a 3 character facility code, a 2 character country code and a 1 character area code.	14	DNNBSBRGSCAGE4
CKTMEND2	Second Ending Station of Circuit. This field is identical to CKTMEND1.	14	VA:NINGNSCAGE4
CKTMMULT	Multipoint Flag. If the circuit is not a multipoint, the field will contain two ASCII zeros. The unique paths will be identified by a 2 digit number placed in the first 2 characters of the original CCSD number. The two characters they replace will be placed in the CKTMMULT fields of the unique paths circuit master records. The connectivity of each path will be given by a chain of circuit routing variable records. The original CCSD will have the connectivity of all paths chained to it.	2	05
CKTMDIRN	Circuit Direction Flag.	1	B

Table 3-3. CKTM-Circuit Master File (sheet 3 of 3)

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
CKTMALTR	Preplanned alt-route flag. If the circuit has no preplanned alt-routes, this field will contain a 0. For those full time circuits with preplanned alt-routes, the number of alt-routes will be contained in this field. The alt-routes paths will be identified by a one-digit number placed in the third character of the original circuit name. The character it replaces will be placed in the CKTMALTR field of the alt-route CCSD master record. The connectivity of the alt-route will be a chain of circuit routing variable records just as a normal CCSD.	1	3

Table 3-4. CSTM-Change of Status Master File (sheet 1 of 2)

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
CSTMROOT	Root Field. This field is maintained by the DBMS and is used as a synonym pointer.	8	
*CSTMCTRL	CCSD Number or Trunk/Channel Number. This field is the record control key and defines the key element for the record. The field contains the 8 character CCSD number of any CCSD that has changed status during the scenario, or the trunk/channel of a CCSD that has been preempted.	10	NDNL111P or 44JMB1/010
CSTMSTAT	Change of Status Flag. This field serves as an indicator of the type of status change. The first byte is the in/out indicator. The second byte is the reason code. 1st byte: I = In O = Out 2nd byte: P = Preempted D = Disrupted R = Restored	2	IR
CSTMDTIM	Disrupted Time. This field contains the time from the start of the scenario that the circuit was disrupted.	4	0011
CSTMRTIM	Restored Time. This field contains the time from the start of the scenario that the circuit was restored. If the circuit was not restored the field will contain 9999.	4	9999
CSTMPTIM	Preempted Time. This field contains the time from the start of the scenario that the circuit was preempted. If the circuit was not preempted it will contain zeros.	4	0000
	*Key Elements		

Table 3-4. CSTM-Change of Status Master File (Sheet 2 of 2)

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
CSTMDATA	Data Area. If the key item contained a CCSD and the status flag was set at 00, then this area will contain the trunk/channel that was disrupted during this time period in the scenario. If the key item contained a trunk channel, then this area would contain the CCSD residing on the channel.	10	44JMB1/010 or NDNL111P
CSTMLKCS	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the Change of Status Variable File (CSTV).	8	

Table 3-5. DCKM-Disrupted Circuits Master File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
DCKMROOT	Root Field. This field is used by the DBMS and used as a synonym pointer.	8	
*DCKMCTRL	Disrupted Circuit Number. This field is the record control key and defines the key element value for the record.	8	DUUC9HMS
DCKMLKDC	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the disrupted circuit variable file (DCKV).	8	

*Key Element

Table 3-6. LNKM-Link Master File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
LNKMROOT	Root Field. This field is maintained by the DBMS and used as a synonym pointer.	8	
*LNKMCTRL	Link Number. This field is the record control key and defines the key element value for the record. The link number is 5 characters and is followed by a trailing blank.	6	M0331
LNKMLKLM	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the link variable file (LNKV).	8	
LNKMLKTR	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the trunk routing file (TRRV).	8	
LNKMDATA	*Link Data Field.* This field is subdivided into the 5 subelements which follow this description.	48	
LNKMTFDM	TDM or FDM Flag. T = TDM, F = FDM	1	T
LNKMTMED	Transmission Media.	22	DCS MICROWAVE
LNKMPLTN	Plotter number	5	63241
LNKMDTGO	Time Link Out of Service. Two characters each to indicate year, month, day, hours, and minutes.	10	7809191223
LNKMDTGI	Time Link Back in Service. This field is identical to LNKMTDGO.	10	7809191223
	*Key Element		

NETM - Network Master File

The Network Master File contains the identifications of various networks and pointers to the circuit list variable file (CKCV). Its main use is to supply information about the specified networks and through the CKCV file to list all circuits in a particular network. NETM data sets and file structure are detailed in Table 3-7.

PTHM - Path Master File

The path concept allows circuits that are routed over the same geophysical locations to be grouped together for easier handling by various report programs. The PTHM file contains the path identification and pointers to the circuit list variable file (CKLV). Access to the CKLV file will supply all circuits on the path. Any given circuit within a path will supply the routing of the path. PTHM data sets and file structures are detailed in Table 3-8.

RPAM - Restoral Path Master File

The Restored Path Master File contains information describing the path of routes that have been made to bridge a disruption of another route in the system. The CCSDs restored over the reroute path are found by interacting with the Restored Path Variable File. RPAM data sets and file structure are detailed in Table 3.9

RRPM - Reroute Path Master File

The Reroute Path Master File contains the list of disrupted endpoints for which a reroute is available. The Reroute Path Master File interacts with the Reroute Path Variable File to obtain all the disrupted circuits between the two endpoints that can be rerouted. RRPM data sets and file structure are detailed in Table 3-10.

Table 3-7. NETM-Network Master File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
NETMROOT	Root Field. This field is maintained by the DBMS and used as a synonym pointer.	8	
*NETMCTRL	Network ID. This field is the record control key and defines the key element value for the record.	8	AUTOVON
NETMLKCL	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the circuit list variable file (CRLV).	8	
	*Key Element		

Table 3-8. PTHM-Path Master File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
PTHMROOT	Root Field. This field is maintained by the DBMS and used as a synonym pointer.	8	
*PTHMCTRL	Path ID. This field is the record control key and defines the key element value for the record. The first character consists of a service availability code, the next three characters consist of the 2nd through 4th characters of the CCSDs traversing the path, the next 4 characters are any set of numbers making the path name unique while the last 4 characters are the number of circuits on the path within parenthesis.	12	AUUC0015(05)
PTHMLKCL	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the circuit list variable file (CRLV).	8	
PTHMDATA	Path Data Field. This field is subdivided into the 5 subelements which follow this description.	70	
PTHMTPOS	Type of Service Code	22	
PTHMEND1	Ending Station of Path. The station ID will contain an 8 character site ID, a 3 character facility code, a 2 character country code and a 1 character area code.	14	DNNRSBRGSCAGE4
PTHMEND2	Second Ending Station of Path. This field is identical to PTHMEND1.	14	VAIHINGNSCAGE4
PTHMDTGI	Time Path Out of Service. Two characters each to indicate year, month, day, hours and minutes.	10	7809191223
PTHMDTGO	Time Path Back in Service. This field is identical to PTHMDTGI.	10	7801191214
	*Key Element		

Table 3-9. RPAM-Restored Path Master File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
RPAMROOT	Root Field. This field is maintained by the DBMS and is used as a synonym pointer.	8	
*RPAMCTRL	Restored End Points. This field is the record control key and defines the key element for the record. The field contains two three-character site codes of the end points of the restored path in alphabetcial order and two bytes to uniquely identify the path between the two stations.	8	BANLKF01
RPAMLKRP	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the restored path variable file (RPAV).	8	
RPAMRTES	Number of routes used in restoring the path.	1	2
RPAMCKTS	Number of circuits on restored path.	2	2
RPAMRRTM	Restoral Time. Time in elapsed minutes from the start of the scenario that the two end points were bridged.	4	0048
RPAMLSTR	List of Routes. This field contains up to six routes used to bridge the break between the two end points. If six routes are not needed the field is blank filled.	48	DONLKFE1BANDONE1
	*Key Element		

Table 3-10. RRPM-Reroute Path Master File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
RRPMROOT	Root Field. This field is maintained by the DBMS and is used as a synonym pointer.	8	
*RRPMCTRL	Reroute End Points. This field is the record control key and defines the key element for the record. The field contains the two three-character site codes of the end points of the break in alphabetical order.	6	BANLKF
RRPMLKRR	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the reroute path variable file.	8	
RRPMRPRS	Reroute Path Status. Status codes are 0 = all circuits rerouted 1 = disrupted but restorable 4 = no reroute path exists at all 9 = no reroute path exists at this path length	1	
RRPMRTES	Number of routes needed to establish reroute	1	2
RRPMCKTS	Number of circuits on reroute path	2	2
RRPMRRTM	Reroute action initiation time. Time when first action is taken on reroute (Elapsed time from scenario start)	4	0027
RRPMCSFL	Continuing Search Flag. Used in restoration to determine if the second path available on the reroute. 0 = Initial search 1 = continued search	1	0
RRPMLSTR	List of routes. This field contains up to six routes required to bridge the break between the two end points. If six routes are needed the field is blank filled.	48	DONLKFE1BANDONE1
	*Key Element		

RTEM - Route Master File

A route is a group of trunks that traverse the same geophysical locations. The Route Master File contains the identifications and other descriptive information pertaining to all identified routes. The Route Master File interacts with the Trunk List (TRLV) Variable file. Access to this file will supply all trunks for a given route. RTEM data sets and file structure are detailed in Table 3-11.

STNM - Station Master File

The Station Master File contains records that describe the physical locations of stations within the DCS. The Station Master File interacts with two variable files, Trunk Routing, and Link. Interaction with the Trunk Routing File will supply information about the various trunks that traverse a given station. All links at a given station are supplied by accessing the Link Variable File. STNM data sets and file structures are detailed in Table 3-12.

THRM - Theater Master File

The Theater Master File contains records that describe the designated ACOC within each theater or, as is the case of the Pacific, the RCOCs within each region. The Theater Master File interacts with the ACOC Access Line file so that all lines connected to the ACOC can be accessed via this linkage path. THRM data sets and file structure are detailed in Table 3-13.

TRCM - Theater Routes Connectivity Master File

The Theater Route Connectivity Master file contains records that describe the route connectivity of stations in the DCS. A route is a group of trunks that traverse and terminate the same geographical locations. The Theater Route Connectivity

Table 3-11 RTEM-Route Master File (sheet 1 of 2)

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
RTEMROOT	Root Field. This field is maintained by the DBMS and is used as a synonum pointer.	8	
*RTEMCTRL	Route ID. This field is the record control key and defines the key element for the record. The route ID will consist of two three-character site ID's for each end of the route, a one character code indicating the area or areas the route traverses and a one digit number making each route name unique. The ending sites are always in alphabetic order.	8	DONLKFE1
RTEMLKTL	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the trunk list variable file (TRLV).	8	
RTEMDATA	Route Data Field. This field is subdivided into the 10 subelements which follow this description.	80	
RTEMCPTY	Route Capacity.	4	0536
RTEMSPAR	Number of spare channels on route.	3	021
RTEMNOPR	Number of non-priority and non-criti~~cal circuits~~ on route.	3	010
RTEMCRIT	Number of non-priority but critical circuits on route.	3	003
RTEMPRIO	Number of priority circuits on route.	3	007
RTEMDTGO	Time Route Out of Service. Elapsed time of route outage (each direction) in minutes.	8	74530243
RTEMSTAT	Route Class and Status where Class 0 routes are non-restorable while Class 1 routes are restorable. For route status, "0" routes are considered operational and "N" routes are considered non-operational.	2	ØN
RTEMHIRP	Highest restoration priority of any circuit on the route.	2	2F
RTEMLORP	Lowest restoration priority of any circuit on the route.	2	00

* Key Element

Table 3-11. RTEM-Route Master File (sheet 2 of 2)

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
RTEMSUPO	Supporting orderwires. (The circuits separated by 2 blanks for multi-directional flags)	50	DOOVWABC ... DOOVWCBS ...

Table 3-12 STNM-Station Master File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
STNMROOT	Root Field. This field is maintained by the DBMS and used as a synonym pointer.	8	
*STNMCTRL	Station ID. This field is the record control key and defines the key element value for the record. The station ID will contain an 8 character site ID, a 3 character facility code, a 2 character country code and a 1 character area code.	14	DNNRSBRGSCAGE4
STNMLKL1	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the link variable file (LNKV).	8	
STNMLKL2	Linkage Field. This field is maintained by the DBMS and defines a second path to the link variable file (LNKV).	8	
STNMLKTR	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the trunk routing variable file (TRRV).	8	
STNMDATA	Station Data Field. This field is subdivided into the five subelements which follow this description.	53	
STNMDTGO	Time Station Outage. Two characters each to indicate year, month, day, hours, and minutes.	10	7809220540
STNMPLTN	Plotter Number.	5	43261
STNMFCLD	Facility Description	20	AUTOVON Switch
STNMSITE	Three character site code.	3	DON
STNMLATL	Latitude and Longitude	15	716245N716245lW
	*Key Element		

Table 3-13. THRM-Theater Master File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
THRMROOT	Root Field. This field is maintained by the DBMS and is used as a synonym pointer.	8	
*THRMCTRL	Theater Name. This field is maintained by the DBMS and defines the key element for the record. The second character of the field is blank.	2	E
THRMACOC	ACOC ID. The ACOC ID is the station ID for the ACOC location. The station ID will contain 8 character site ID, a 3 character facility code, a 2 character country code and a 1 character area code.	14	VAIHIGNDACGE4
THRMLKAA	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the ACOC access line variable file (AALV).	8	
	*Key Element		

Master file contains a list of stations and associated routes. If there are more routes connected to the station than allowed for in the Theater Route Connectivity Master File, then the excess is contained in the Theater Route Connectivity Variable file. TRCM data sets and file structure are detailed in Table 3-14.

TRKM - Trunk Master Files

The Trunk Master File contains descriptive information pertaining to the trunks in the Circuit Routing (CKRV), Trunk List (TRLV) and Trunk Routing (TRRV) variable files. Interaction with the TRRV file will supply information about the various stations and links that the trunk traverses while interaction with the TRLV file will supply the route for a given circuit. All circuits on the trunk can be obtained through accesses of the CKRV Variable File. TRKM data sets and file structure are detailed in Table 3-15.

WSLM - Working Station Master File

The Working Station Master contains information describing the working status of stations involved in rerouting circuits: WSLM data sets and file structure are detailed in Table 3-16.

WTLM - Working Time Log Master File

The Working Time Log Master File contains the log of a Tech controllers reroute activity time in each facility. The tech controllers activity is logged by route. WTLM data sets and file structure are detailed in Table 3-17.

AALV - ACOC Access Line Variable File

The ACOC Access Line Variable File provides easy access to all the technical control facility to ACOC communications lines in the DCS. This file contains descriptive information about each circuit as well as linkage paths to the ACOC access

Table 3-14. TRCM-Theater Route Connectivity Master File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
TRCMROOT	Root Field. This field is maintained by the DBMS and is used as a synonym pointer.	8	
*TRCMCTRL	From Station ID. This field is the record control key and defines the key element for the record. The field contains a three character site code.	3	LKF
TRCMLKTR	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the theater route connectivity variable file.	8	
TRCMRCNT	Route Count. This field indicates the number of other stations linked to the "from" station.	2	6
TRCMLST1	To Station ID. This field is five bytes long and consists of a three byte station code, a 1 byte theater code and a 1 byte route number.	5	DONE1
TRCMLST2	To Station ID. This field has the same description as TRCMLST1. It is used only when there is more than one station connected to the "from" station.	5	FELE1
TRCMLST3	To Station ID. As above.	5	PMSE1
TRCMLST4	To Station ID. As above.	5	BANE1
TRCMLST5	To Station ID. As above.	5	BANE2
	*Key Element		

Table 3-15. TRKM-Trunk Master File (sheet 1 of 2)

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
TRKMROOT	Root Field. This field is maintained by the DBMS and used as a synonym pointer.	8	
*TRKMCTRL	Trunk Number. This field is the record control key and defines the key element for the record.	6	44JMB1
TRKMLKTR	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the trunk routing variable file (TRRV).	8	
TRKMLKTL	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the trunk list variable file (TRLV).	8	
TRKMLKCR	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the circuit routing variable file (CRRV).	8	
TRKMDATA	Trunk Data Field. This field is subdivided into the 12 subelements which follow the description.	46	
TRKMHIRP	Highest restoration priority of the CCSDs on the trunk.	2	1B
TRKMLORP	Lowest restoration priority of the CCSDs on the trunk.	2	00
TRKMAVAL	Trunk availability code	1	B
TRKMFTDM	TDM or FDM code T = TDM F = FDM	1	T
TRKMDTGI	Time the trunk back in service. Two characters each to indicate year, month, day, hours and minutes.	10	7801190530
	*Key Element		

Table 3-15. TRKM-Trunk Master File (sheet 2 of 2)

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
TRKMDTGO	Time trunk out of service. This field is identical to TRKMDTGI.	10	7812200345
TRKMBITR	Bit Rate on Bandwidth	5	1.5MB
TRKMCPTY	Trunk Capacity	4	025T
TRKMMLGE	Trunk Mileage	2	
TRKMCOST	Trunk Cost	1	
TRKMVFCT	VFCT CCSD Number. This field will be blank for all non-VFCT trunks.	8	DTXX6E95
TRKMCHLS	This element will contain a two character field for the highest restoration priority for each channel of the trunk as well as the number of circuits on the channel.	72	1A12F3....

Table 3-16. WSLM-Working Station Master File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
WSLMROOT	Root Field. This field is maintained by the DBMS and is used as a synonym pointer.	8	
*WSLMCTRL	Work Station ID. This field is the record control key and defines the key element for the record. The field contains the 8 character site ID of a station working on a reroute path, a 3 character facility code, a 2 character country code and a 1 character area code.	14	LANGRKPFTCFGE4
WSLMSITE	Site ID. This field contains the 3 character site code ID for the work station.	3	
	*Key Element		

Table 3-17. WTLM-Working Time Log Master File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
WTLMROOT	Root Field. This field is maintained by the DBMS and is used as a synonym pointer.	8	
*WTLMCTRL	Route ID. This field is the record control key and defines the key element for the record. The route ID will consist of two three-character site ID's for each end of the route, a one character code indicating the area or areas the route traverses and a one digit number making each route name unique. The ending sites are always in alphabetic order.	8	DONLKFE1
WTLMHCR1	First direction hour counter. This field will keep track of the number of hours elapsed from the start of the scenario. The purpose of it is to reduce the number of bytes in the work time log by not having to keep track of every minute of the scenario. The hour counter keeps track of start of the working time log.	2	00
WTLMWKT1	First direction working time log. Minutes log. Each byte of the record will represent a minute of work by the tech controller. If no work is done by a tech controller in a particular minute then a zero is put in the byte representing that minute. If he was working on a reroute path then a 1 is inserted into the field.	360	00111100....
WTLMHCR2	Second direction hour count. Same as WTLMHCR1 except for the opposite direction.	2	00
WTLMWKT2	Second direction working time log. Same as WTLMWKT2 except for the opposite direction.	360	11000011....
	*Key Element		

Line Master File, the ACOC Theater Master File, and the Theater Master File. Interaction with these files provides information about the technical control reporting station circuits within the theater. AALV data sets and file structures are detailed in Table 3-18.

CKLV - Circuit Listing Variable File

The Circuit Listing Variable File (CKLV) provides an easy access to all circuits on a given path. It also allows all circuits within a particular network to be readily identified. Detailed information concerning paths, circuits and networks can be obtained through the Path, Circuit and Network Master files respectively. CKLV data sets and file structure are detailed in Table 3-19.

CKRV - Circuit Routing Variable File

The Circuit Routing Variable File (CKRV) contains the routing of the DCS circuits in terms of the trunks and the channels they traverse. Detailed information concerning a given circuit is found by accessing the circuit master file (CRTM). Accessing the Trunk Master File (TRKM) will provide detailed information about the trunks listed in the CKRV file. CKRV data sets and file structure are detailed in Table 3-20.

CSTV - Change of Status Variable File

The Change of Status Variable File is used to store CCSD and trunk/channel information for reroute paths. The Change of Status Variable File is linked to the Change of Status Master File. By interaction with these two files information about a CCSD status can be obtained. CSTV data sets and file structure are detailed in Table 3-21.

Table 3-18. AALV-ACOC Access Line Variable File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
*AALVCCSD	CCSD Number. This field is a record control key and defines the key element value. It contains the CCSD name of a circuit that originates at either a reporting station of CCSD.	8	DDDA9SLN
AALVTHTR	Theater ID. This field contains the theater in which the circuit can be found. The second character is blank.	2	E
AALVCTYP	Type of Circuit. Circuit class code where RA = dedicated CCSs, Reporting Station to ACOC RD = AUTODIN Access lines, Reporting Station to AUTODIN Network RV = AUTOVON Access lines, Reporting Station to AUTOVON Network AD = ACOC-AUTODIN Lines, ACOC to AUTODIN Network AV = ACOC-AUTOVON Lines, ACOC to AUTOVON Network	2	AD
AALVRPTS	Reporting Station ID. This field contains the 14 character code for the reporting station that the access line is connected.	14	LANGRKPFTCFGE4
AALVTIME	In Time. This field contains the in time of the circuit in case it was disrupted. If the circuit had not been disrupted then the field would contain 0000. If the circuit had been disrupted but not restored the field would contain 9999.	4	0150
THRMLKAA	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the Theater Master File (THRM).	8	
ATCMLKAA	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the ACOC theater connectivity master file (ATCM).	8	
AALMLKAA	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the ACOC access line master file (AALM). *Key Element	8	

Table 3-19. CKLV-Circuit Listing Variable File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
*CKLVPTHM	Path ID. This field is a record control key and defines a key element value. The first character consists of a service availability code, the next three characters consist of the 2nd through 4th characters of the CCSDs traversing the path, the next 4 characters are any set of numbers making the path name unique while the last 4 characters are the number of circuits on the path within parenthesis.	12	AUUC0051(05)
PTHMLKCL	Linkage Field. This field is maintained by the DBMS and defines the linkage path from the path master file (PTHM).	8	
*CKLVCKTM	Circuit Number. This field is a record control key and defines a key element value.	8	DUUC9HMS
CKTMLKCL	Linkage Field. This field is maintained by the DBMS and defines the linkage path from the circuit master file (CKTM).	8	
*CKLVNETM	Network ID. This field is a record control key and defines a key element value.	8	AUTOVON
NETMLKCL	Linkage Field. This field is maintained by the DBMS and defines the linkage path from the network master file (NETM).	8	
	*Key Element		

Table 3-20. CKRV-Circuit Routing Variable File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
*CKRVCKTM	Circuit Number. This field is a record control key and defines a key element value.	8	DUUC9HMS
CKTMLKCR	Linkage Field. This field is maintained by the DBMS and defines the linkage path from the circuit master file (CKTM).	8	
*CKRVTRKM	Trunk Number. This field is a record control key and defines a key element value.	6	44JMB1
TRKMLCKCR	Linkage Field. This field is maintained by the DBMS and defines the linkage path from the trunk master file (TRKM).	8	
CKRVCHAN	Channel of trunk over which the CCSD is routed.	3	006
	*Key Element		

Table 3-21. CTSV-Change of Status Variable File

ELEMENT NAME	DESCRIPTION	BYTE	EXAMPLE
*CSTVCCSD	CCSD Number of Trunk/Channel Number. This field is the record control key and defines the key element value. The field contains the eight character CCSD number followed by two blanks, or the trunk/channel number of a CCSD that has been preempted.	10	NDNL111P or 44JMB1/010
CSTMLKCS	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the change of status master (CSTM) file.	8	
CSTVDATA	Data Area. If the key item contained a CCSD and then this field will contain the trunk/channel that was disrupted during this time period in the scenario. If the key item was a trunk/channel number then this area would contain the CCSD residing on the channel.	10	44JMB1/010 or NDNL111P
	*Key Element		

DCKV - Disrupted Circuit Variable File

The Disrupted Circuits Variable File contains information about disruptions (the endpoints involved) for each circuit disrupted in the scenario. The data from this file is used in creating Reroute Path Master and Reroute Path Variable Files. DCKV data sets and file structure are detailed in Table 3-22.

LNKV - Link Variable File

The Link Variable File provides an easy access to all links at a given site. Both ends of a link are listed with the link ID and so only one record entry per link is required. Detailed link information can be accessed through the Link Master file (LNKM). Detailed station information can be accessed through the Station Master File (STNM). LNKV data sets and file structure are detailed in Table 3-23.

RPAV - Restoral Path Variable File

The Restored Path Variable File contains descriptive material about the CCSDs restored on a particular reroute path. RPAV data sets and file structure are detailed in Table 3-24.

RRPV - Reroute Path Variable File

The Reroute Path Variable File contains the list of CCSDs to be rerouted between two points plus some descriptive information about each. The Reroute Path Variable File is linked to the Reroute Path Master File which contains the information about the reroute. RRPV data sets and file structure are detailed in Table 3-25.

TRCV - Theater Route Connectivity File

The Theater Route Connectivity Vairable File contains a list of stations and associated routes which represent the

Table 3-22. DCKV-Disrupted Circuit Variable File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
*DCKVCCSD	CCSD Number. This field is a record control key and defines the key element value. It contains the CCSD name of the disrupted circuit.	8	DVUC9HMS
*DCKMLKDC	Linkage Field. This field is maintained by the DBMS and defines the linkage path from the disrupted circuits master file (DCKM).	8	
DCKVDEND	Disrupted Endpoints. This field contains the two three-character site codes where the disruption is between. The field will be maintained in alphabetic order.	6	BANLKF
DCKVTOUT	Outage Time. This field contains the time that the outage occurred as measured from the start of the scenario.	4	0015
	*Key Element		

Table 3-23. LNKV-Link Variable File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
*LNKVSTN1	Station ID. This field is a record control key and defines the key element value. The station ID will contain an 8 character site ID, a 3 character facility code, a 2 character country code and a 1 character area code.	14	VAIHINGNSCAGE4
STNMLKL1	Linkage Field. This field is maintained by the DBMS and defines the linkage path from the station master file (STNM).	8	
*LNKVSTN2	Station ID. This field is a record control key and defines the key element value. It is identical to LNKVSTN1.	14	DNNRSBRGSCAGE4
STNMLKL2	Linkage Field. This field is maintained by the DBMS and defines a second linkage path from the station master file (STNM).	8	
*LNKVLNLD	Link Number. This field is a record control key and defines the key element value for the record. The link ID is 5 characters followed by a trailing blank.	6	M0671
LNKMLKLM	Linkage Field. This field is maintained by the DBMS and defines the linkage path from the link master file (LNKM).	8	

*Key Element

Table 3-24. RPAV-Restored Path Variable File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
*RPAVEDPT	Restored Path Endpoints. This field is a record control key and defines a key element value. The Field contains two three-character site codes of the endpoints of the restored path in alphabetic order and two bytes to uniquely identify the path between the two stations.	8	BANLKF01
RPAMLKRP	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the restored path master file (RPAM).	8	
RPAVCCSD	CCSD Number. This field contains the circuit ID which was restored between these two endpoints.	8	NDNL111P
RPAVREST	Restoration priority of the CCSD	2	1B
RPAVCKRT	CCSD Restoral Time. The time at which this particular circuit was restored on this path.	4	0100
	*Key Element		

Table 3-25. RRPV-Reroute Path Variable File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
*RRPVEDPT	Reroute Path Endpoints. This field is the record control key and defines a key element value. The field contains two three-character site code of the endpoints of the break in alphabetic order.	6	BANLKF
RRPMLKRR	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the reroute path master file (RRPM).	8	
RRPVCCSD	CCSD Number. This field contains the CCSD ID of a circuit that has been disrupted between these two endpoints.	8	NDNL111P
RRPVREST	Restoration Priority. This field contains the two character restoration priority of the CCSD.	2	1B
	*Key Element		

physical connectivity of stations. This file is linked to the Theater Route Connectivity Master File which also contains the same data but for a different set of stations. The Theater Route Connectivity Variable File is used only when a particular station is connected by more than 5 different routes. TRCV data sets and file structure are detailed in Table 3-26.

TRLV - Trunk Listing Variable File

The Trunk List Variable File (TRLV) provides an access to all trunks on a given route. Detailed route information can be accessed through the Route Master File (RTEM). Detailed trunk information can be accessed through the Trunk Master File (TRKM). TRLV data sets and file structure are detailed in Table 3-27.

TRRV - Trunk Routing Variable File

The Trunk Routing Variable File provides the routing of the DCS trunks in terms of the stations and links the trunks traverse. Detailed information about the stations and links is provided in the Station Master File (STNM) and Link Master File (LNKM) respectively. TRRV data sets and file structure are detailed in Table 3-28.

3.2 Data Base Sizing

The total size of the CRAM data base is 50.1 megabytes. Tables 3-29 and 3-30 provide record sizes, file capacities and total file sizes for the connectivity and restoral sections of the data base, respectively.

3.3 Data Base Build Process

The primary source of data used in building the CRAM data base was the DCA World Wide On Line System (WWOLS). CSC was supplied with tape extracts from the WWOLS which contained the complete circuit and trunk lists for the European DCS. Other

Table 3-26 TRCV-Theater Route Connectivity File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
*TRCVFNOD	Site ID. This field is the record control key and defines a key element value. The field contains a three character site ID.	3	LKF
TRCMLKTR	Linkage Field. This field is maintained by the DBMS and defines the linkage path to the theater route connectivity master (TRCM) file.	8	
TRCVLST1	To Station ID. This field is 5 bytes long and consists of a 3 byte station code, a 1 byte theater code and a 1 byte route number.	5	FRIE1
TRCVLST2	To Station ID. As above.		
TRCVLST3	To Station ID. As above.		
TRCVLST4	To Station ID. As above.		
TRCVLST5	To Station ID. As above.		
	*Key Element		

Table 3-27. TRLV-Trunk Listing Variable File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
*TRLVRTEM	Route ID. This field is a record control key and defines a key element value. The route ID will consist of two three-character site IDs for each end of the route, a 1 character code indicating the area or areas the route traverses and a one digit number making each route name unique. The ending sites are always in alphabetic order.	8	DONLKFE1
RTEMLKTL	Linkage Field. This field is maintained by the DBMS and defines the linkage path from the route master file (RTEM).	8	
*TRLVTRKM	Trunk Number. This is a record control key and defines a key element value.	6	44JMB1
TRKMLKTL	Linkage Field. This field is maintained by the DBMS and defines the linkage path from the trunk master file (TRKM).	8	
	*Key Element		

Table 3-28 TRRV-Trunk Routing Variable File

ELEMENT NAME	DESCRIPTION	BYTES	EXAMPLE
*TRRVTRKM	Trunk Number. This field is a record control key and defines the key element value.	6	44JMB1
TRKMLKTR	Linkage Field. This field is maintained by the DBMS and defines the linkage path from the trunk master file (TRKM).	8	
*TRRVSTNM	Station ID. This field is a record control key and defines the key element value. The station will contain an 8 character site ID, a 3 character facility code, a 2 character country code and a 1 character area code.	14	DNNRSBRGSCAGE4
STNMLKTR	Linkage Field. This field is maintained by the DBMS and defines the linkage path from the station master file (STNM).	8	
*TRRVLNTR	Link Number. This field is a record control key and defines the key element value. The link number is 5 characters followed by a trailing blank.	6	M0063
LNKMLKTR	Linkage Field. This field is maintained by the DBMS and defines the linkage path from the link master file (LNKM).	8	
	* Key Element		

Table 3-29. Connectivity Data Base Sizing

FILE NAME	RECORD SIZE	CAPACITY	TOTAL
THRM (Theatre Master)	32	10	.000512
ATCM (ACOC Theatre Conn. Master)	44	300	.014336
LNKM (Link Master)	78	4000	.312000
STNM (Station Master)	99	6000	.594000
TRKM (Trunk Master)	156	20000	3.120000
RTEM (Route Master)	104	4000	.416000
TRCM (Theatre Route Conn, Master)	46	7000	.326144
NETM (Network Master)	24	10	.000240
PTHM (Path Master)	98	40000	3.920000
CKTM (Circuit Master)	99	120000	11.760000
AALM (ACOC Access Line Master)	26	3000	.080896
LNKV (Link Master)	58	4000	.232000
TRCV (Theatre Route Conn. Var.)	36	2000	.073216
TRRV (Trunk Routine Var.)	50	80000	4.000000
TRLV (Trunk List Var.)	30	20000	.600000
CKRV (Circuit Routine Var.)	33	450000	14.850000
CKLV (Circuit List Var.)	52	120000	6 240000
AALV (ACOC Access Line Var.)	54	3000	.171008
		TOTAL	46.710352

Table 3-30. Restoral Data Base Sizing

FILE NAME	RECORD SIZE	CAPACITY	TOTAL (Megabytes)
DCKM (Disrupted Circuits Master)	24	5000	.122368
RRPM (Reroute Path Master)	79	2000	.171008
RPAM (Restoral Path Master)	79	2000	.171008
CSTM (Change of Status Master)	50	10000	.512000
WSCM (Work Station Master)	25	300	.007680
WTLM (Work Time Log Master)	740	2000	1.48000
DCKV (Disrupted Circuit Variable)	26	5000	.135168
RPAV (Restored Path Variable)	36	10000	.301568
RRPV (Reroute Path Variable)	24	10000	.244224
CSTV (Change of Status Variable)	28	10000	.284672
		TOTAL	3.429696

data sources included DCA circulars and CSC generated data.

The restoral section of the data base does not require any data entry prior to the execution of the CRAM algorithm, but contains working files used for temporary storage and manipulation of data during program execution. The connectivity section of the data base contains the DCS connectivity and other static data required by the CRAM. Information in the connectivity section of the data base must be loaded prior to execution of the algorithm. Figure 3-2, and the following discussion detail the connectivity data base load process.

(A) Convert the circuit tapes to ASCII format. The output file may be on disk or tape or both.

(B) Sample the converted files in order to determine, in general, the contents and format.

(C) Create the circuit master and circuit routing variable records which are loaded into the data base. In the process of reading the circuit connectivities, link and trunk names must be assigned where names are not assigned by DCA. A direct file with these dummy keys is kept. The stations that these dummy links connect is also used to form station master records since there is no guarantee that these stations will appear on the trunk tape. Pre-planned alt-route, multipoint and undirectional circuits are handled in this module.

(D) Convert the trunk tape to ASCII format. The output file may be on disk or tape or both.

(E) Sample the converted files in order to determine in general the contents and format.

(F) Create trunk master and trunk routing variable records which are to be loaded into the data base. In the process of reading the trunk connectivities, station master records, link master

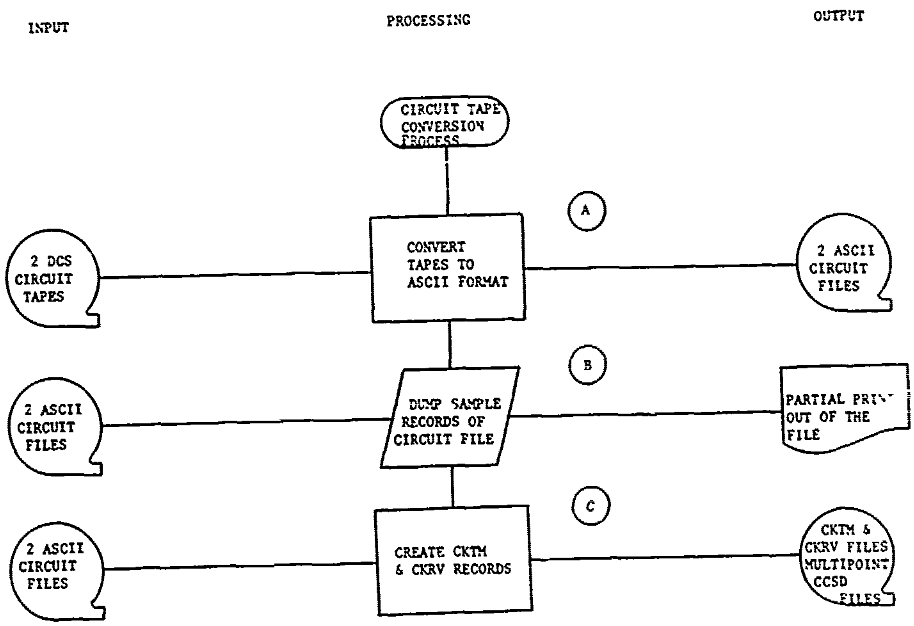


Figure 3-2. Data Base Build Process (sheet 1 of 5)

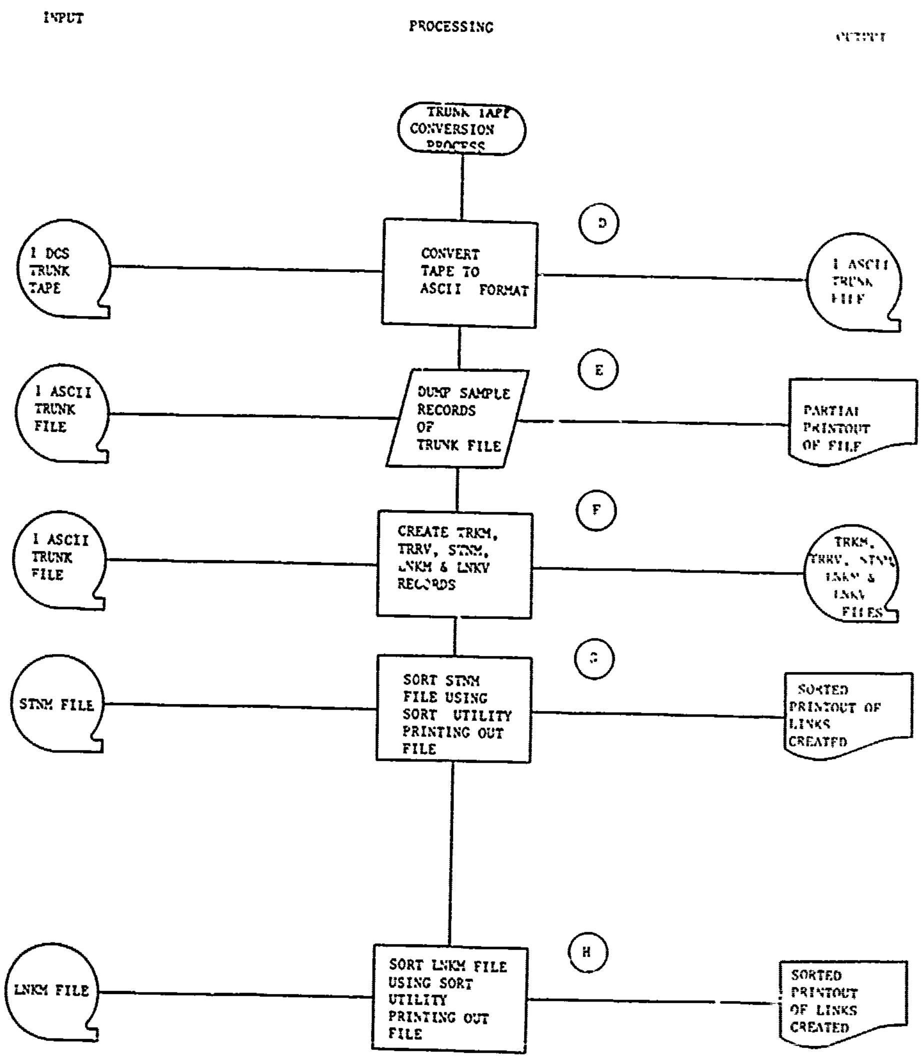


Figure 3-2. Data Base Build Process (sheet 2 of 5)

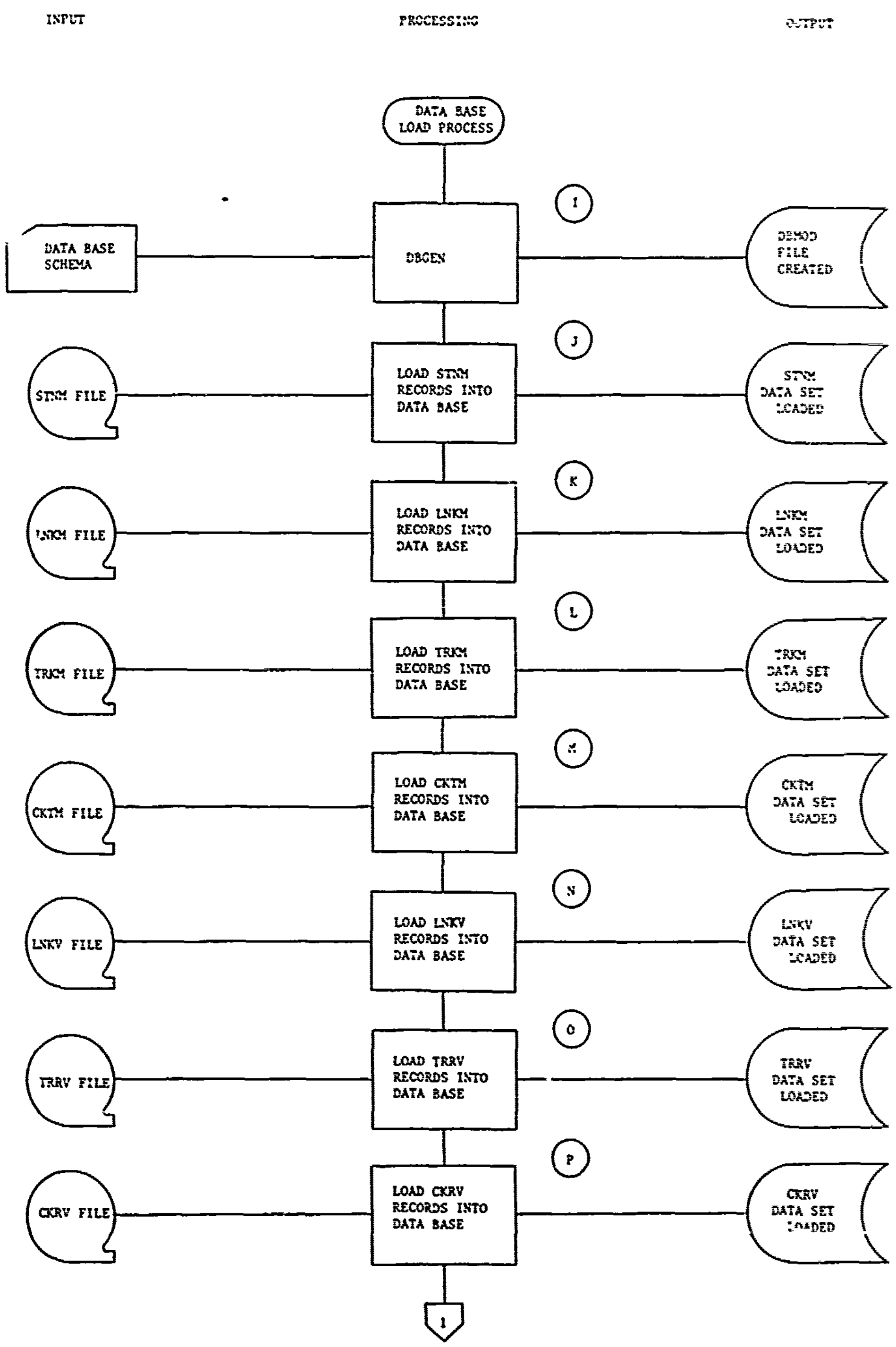


Figure 3-2. Data Base Build Process (sheet 3 of 5)

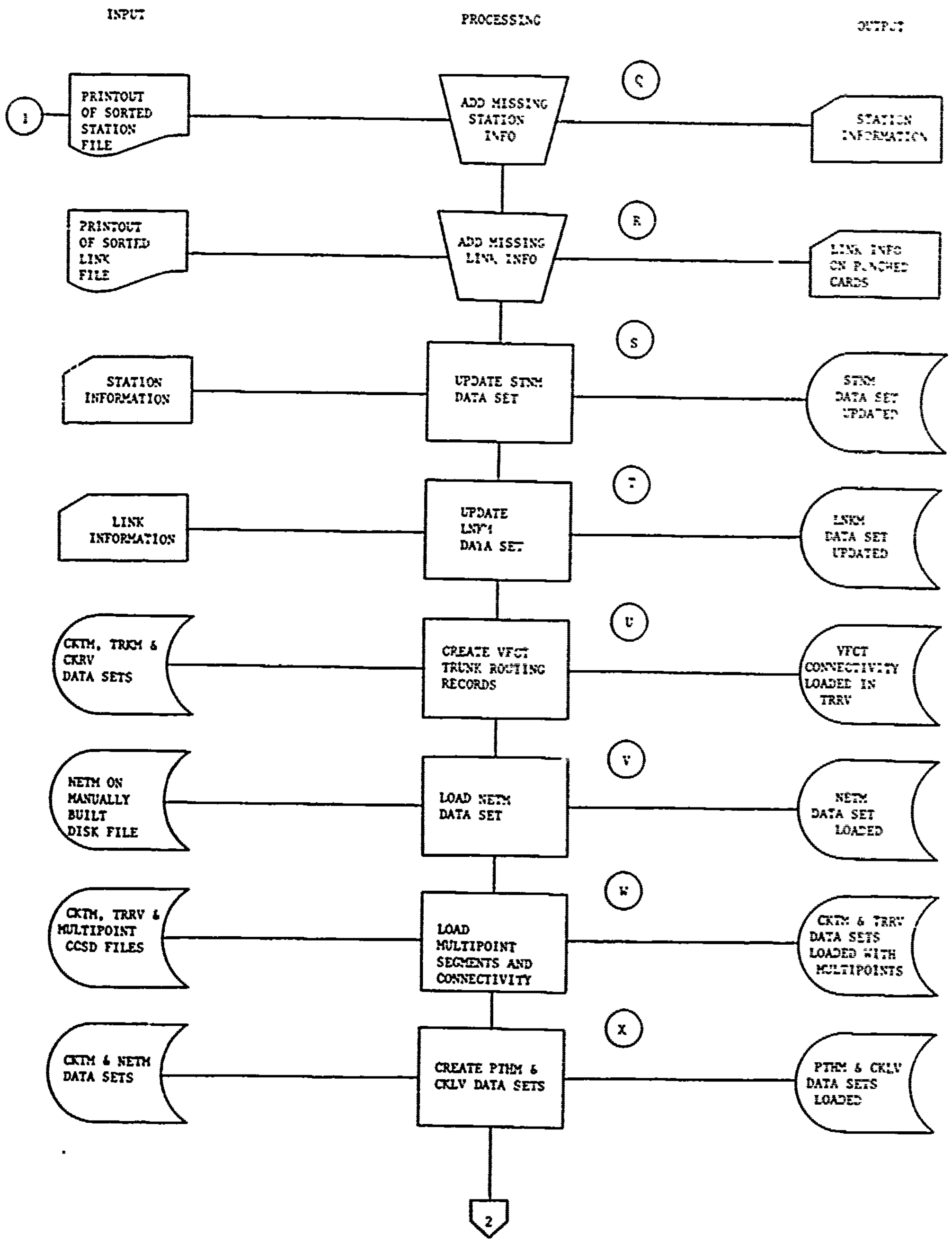


Figure 3-2. Data Base Build Process (sheet 4 of 5)

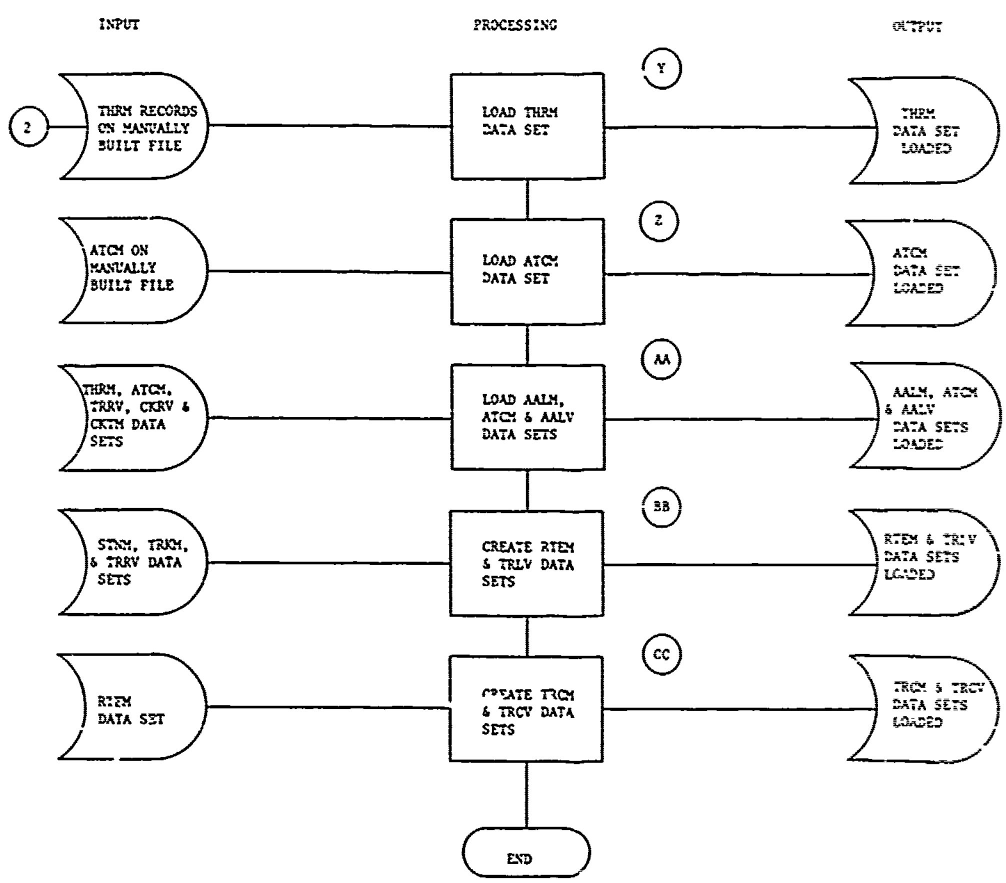


Figure 3-2. Data Base Build Process (sheet 5 of 5)

records and link variable records are formed. Some of the link records are for CSC assigned link identifiers. These links are added to the file of CSC assigned trunks and links created in step (C) . A trunk master record will be created for each trunk. However, no routing records will be created for VFCT trunks.

(G) Use a SORT utility to sort the station master records created in step (F) and print the sorted file. This file is used as a list of all the stations for which information must be gathered.

(H) Use a SORT utility to sort the link master records created in step (F) , printing the resulting sorted file. This file is used as a list of all the links for which information must be gathered.

(I) Create the DBMOD file (Data Base Descriptor Table) by running the DBGEN program with the CRAM data base schema as input.

(J) Load the station master data set using the station file generated in step (G) . This file includes all station names. Other station data is not included at this time.

(K) Load the link master data set using the link file generated in step (H) . This file will include DCS links and dummy links assigned.

(L) Load the trunk master data set using the trunk file generated in step (F) . This file includes all DCS trunks and dummy trunks assigned.

(M) Load the circuit master data set using the circuit file generated in step (C) . This file includes all DCS circuits including unidirectional, multipoint and pre-planned alt-route circuits.

(N) Load the link variable data set using the link file generated in step (F) . This file includes all DCS links and dummy links assigned.

(O) Load the trunk routing variable data set using the trunk file generated in step (F) . This file includes DCS trunks and dummy trunks assigned but does include VFCT trunk routing.

(P) This step involves the loading of the circuit routing variable data set using the circuit file generated in step (C) . This file will include all circuits including unidirectional, multipoint and pre-planned alt-route circuits.

(Q) Collect missing station information for those stations loaded into the data base. These stations will be found in the printout of the station master load file generated in step (G) . The missing information includes latitude, longitude, three letter site code, station description code and plotter number. The source of this data is DCS circular and CSC documentation.

(R) Collect missing link information for those links loaded into the data base. These links are found in the printout of the link master load file generated in step (H) . The missing information includes the plotter number for each link.

(S) Update the station master records with the information gathered in step (Q) . The information source is punched cards.

(T) Update the link master records with the information gathered in step (R) . The information source is punched cards.

(U) Load the VFCT trunk connectivity. The source of information is the circuit and trunk master data sets and trunk routing variable data set generated in steps (M) , (L) , and (P) , respectively.

(V) Load the network master data set. The information is read from a disk file and loaded directly into the data base. The number of records to be loaded is less than twenty so the file is generated manually.

(W) Load the connectivity records for each segment of the multipoint circuits. The source of information is the extraction of the DCS circuits tapes (C), and the trunk routing and circuit master records generated in steps (M) and (O).

(X) Load the path master and circuit list variable data sets. The information source is the circuit master file generated in step (M) and the circuit routing and trunk routing variable data sets. The process involves sorting these circuits on endpoints, analyzing the connectivity for those with the same endpoints and assigning the path names accordingly.

(Y) Load the theater master data set from a manually constructed disk file. The number of records is small enough that the manual build of the disk file is justifiable.

(Z) Load the ACOC theater connectivity master with all reporting stations in the DCS. The input is a manually constructed disk file.

(AA) Load the ACOC access line master and variable data sets. The input will come from the data base records already entered including the theater, ACOC theater connectivity and circuit master as well as routing and circuit routing variable files generated in steps (Y), (Z), (O), (P), and (M), respectively.

(BB) Generate the route master file and trunk list variable file. The information source is the trunk and station master files as well as the trunk routing file generated in steps (L), (J), and (O), respectively. All input is strictly within the data base.

(CC) Load the theater route connectivity master and variable data set. The input is the route master file generated in step (C).

SECTION 4 - SAMPLE OUTPUTS

Figures 4-1 through 4-4 show four specific types of outputs from the CRAM. These outputs show the impact of losing a major node (classified name) in the European DCS.

Figure 4-1 shows a summary of all reroute actions as a result of the damage scenario. It identifies the total number of reroutes attempted and the number completed. The summary of completed reroutes is grouped according to reroute path length to show the number of routes required in tandem to satisfy the reroute requirements.

Figure 4-2 shows a summary of the effect of the scenario on ACOC connectivity. ACOC connectivity is composed of critical control communications circuits between the ACOC and the technical control facilities. Based upon the circuits surviving the damage scenario, an estimate of ACOC effectiveness is calculated. This quantity is then used as a weighting factor in calculating the response times for circuit restoral.

Figure 4-3 lists the circuits by CCSD which were preempted as a result of restoring higher priority circuits.

Figure 4-4 is a circuit status table showing the status of all circuits in a given theater of operation after a damage scenario and subsequent restoral actions have been taken. The status of all or selected circuits can be provided. Circuits not affected by the scenario are also listed. Disrupted circuits are listed together with restoral times, restoral actions, and remarks to indicate why unrestored circuits could not be restored. This table is useful in determining the impact of damage to the system and the ability of the system control to utilize remaining resources to restore critical high priority circuits.

REROUTE SUMMARY

NO. OF CIRCUITS ATTEMPTED:0043

NO. OF CIRCUITS REROUTED:036

REROUTE PATH LENGTH (ROUTES)	NO. OF CIRCUITS REROUTED	PERCENTAGE OF TOTAL CIRCUITS REROUTED
1	02	006
2	16	044
3	13	036
4	05	014
		100

Figure 4-1. Reroute Summary

ACOC CONNECTIVITY
THEATER: EUROPE

	INITIAL CONNECTIVITY (CIRCUITS)	CONNECTIVITY AFTER DISRUPTION (CIRCUITS)	CONNECTIVITY AFTER RESTORAL (CIRCUITS)
CRITICAL CONTROL CIRCUITS	[illegible]7	[illegible]4	87
AUTOVON ACCESS LINES	91	6[illegible]	61
AUTODIN ACCESS LINES	53	29	36
ACOC EFFECTIVENESS (PERCENTAGE OF CONNECTIVITY REMAINING TO SURVIVING STATIONS)	1[illegible]	[illegible]5[illegible]	**

Figure 4-2. ACOC Connectivity Summary

PREEMPTED CIRCUITS

PAGE 001 OF 001

TOTAL = 079

CCSD	RP	CCSD	RP	CCSD	RP	CCSD	RP	CCSD	RP
----	--	----	--	----	--	----	--	----	--
[illegible]	1G	[illegible]	2I	DT1X6F94	1D	JM1V*ENZ	2F	DUBB9DF8	00
[illegible]	[illegible]	[illegible]	[illegible]	JM1VDS10	2E	JM1VC592	2E	RC1E9HBT	1G
[illegible]	[illegible]	[illegible]	2F	JD*V*BJS	[illegible]	JMDV*EFX	2E	UUBV*891	0P
[illegible]	2A	[illegible]	1G	DUUC9ADQ	1G	UUBB9ASM	00	UK1E9GKR	1G
[illegible]	[illegible]	[illegible]	3A	JD1VC14B	3A	JM1V*EF7	2E	DUUC9ADB	1G
[illegible]	2E	[illegible]	[illegible]	DUUC9DDX	00	UUBB9CBK	00	UUBYC775	00
[illegible]	[illegible]	[illegible]	[illegible]	UUB99A**	[illegible]	JM1V*EFZ	2E	DUUC9CCR	1G
[illegible]	3A	[illegible]	[illegible]	DTPX6D63	[illegible]	UUBVD831	00	DUUC9DJZ	00
[illegible]	2E	[illegible]	[illegible]	UU1E9HMD	1G	UUBB9ASN	[illegible]	UK1E9GNR	1G
[illegible]	[illegible]	C9CCV	[illegible]	JD*V*ANT	3A	DUUC9CJV	00	JU1V*EBT	00
[illegible]	[illegible]	[illegible]	[illegible]	DUUC9ADA	1C	DUUC9CCX	[illegible]	UUBB9CBJ	00
[illegible]	[illegible]	[illegible]	2E	JMDV*ULS	2E	JGJJC6G6	2F	DUUC9CCN	1G
[illegible]	2I	[illegible]	2E	JD*V*M5F	3A	JUBV*B9X	[illegible]	TURVDN50	1D
[illegible]	[illegible]	[illegible]	[illegible]	JJGV*ABZ	2C	DUUC9CCY	00	JM1V*EE6	00
[illegible]	[illegible]	[illegible]	[illegible]	UUBB9CXZ	[illegible]	DU1F9GJT	1G	ND1B1E43	1C
[illegible]	3A	[illegible]	[illegible]	DUUC9ADT	22	JM1V*EFM	2E		

Figure 4-3. Preempted Circuit Summary

CIRCUIT STATUS

CIRCUITS: [illegible]

PAGE [illegible] OF [illegible]26

CCSD	[illegible]	STATUS	REST.TIME(MIN)	ACTION
[illegible]	1	DISRUPTED END TERMINAL	9999	NOT RESTORABLE
[illegible]	1	NOT DISRUPTED	[illegible]	
0TXX6[illegible]51	1C	NOT DISRUPTED	[illegible]	
RCY[illegible]X56	1	NOT DISRUPTED	[illegible]	
0TXX[illegible]E9[illegible]	1C	NOT DISRUPTED	[illegible]	
[illegible]TXX6G93	1C	NOT DISRUPTED	[illegible]	
RCY0[illegible]A[illegible]C	1[illegible]	NOT DISRUPTED	[illegible]	
0UUC9CC[illegible]	1G	NOT DISRUPTED	[illegible]	
RCY0JG6[illegible]	1[illegible]	DISRUPTED	9999	MULTIPT NON-RESTORABLE
[illegible]1Y0JG6[illegible]	1[illegible]	NOT DISRUPTED	[illegible]	
[illegible]2Y0JG6[illegible]	1[illegible]	NOT DISRUPTED	[illegible]	
[illegible]3Y0JG6[illegible]	1	NOT DISRUPTED	[illegible]	
0UUC[illegible]4[illegible]8	1G	DISRUPTED END TERMINAL	9999	NOT RESTORABLE
0UUC9C[illegible]V	1C	DISRUPTED END TERMINAL	9999	NOT RESTORABLE
0UUC9CCT	1G	PREEMPTED	9999	
0UUC9D2J	1C	DISRUPTED	[illegible]114	REROUTED
[illegible]D0VAGGP	1A	DISRUPTED	[illegible]42[illegible]	REROUTED
JC[illegible]V9[illegible]88	1[illegible]	NOT DISRUPTED	[illegible]	
0D0A[illegible]A[illegible]1	1A	NOT DISRUPTED	[illegible]	
[illegible]10A[illegible]AH1	1A	NOT DISRUPTED	[illegible]	
[illegible]20A[illegible]AH1	1A	NOT DISRUPTED	[illegible]	
[illegible]30A[illegible]AH1	1A	NOT DISRUPTED	[illegible]	
0UUC9CVX	1G	NOT DISRUPTED	[illegible]	
NONO1R32	1C	NOT DISRUPTED	[illegible]	
BCTA[illegible]ETR	1D	NOT DISRUPTED	[illegible]	
RCYV[illegible]536	1D	NOT DISRUPTED	[illegible]	
JD0V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
[illegible]10V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
[illegible]20V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
[illegible]30V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
[illegible]40V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
[illegible]50V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
[illegible]60V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
[illegible]70V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
[illegible]80V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
[illegible]90V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
1[illegible]0V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
11[illegible]V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
12[illegible]V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
13[illegible]V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
14[illegible]V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
15[illegible]V0J6[illegible]	1E	NOT DISRUPTED	[illegible]	
0TXX6[illegible]33	1[illegible]	NOT DISRUPTED	[illegible]	
0T1X6[illegible]33	1[illegible]	NOT DISRUPTED	[illegible]	
[illegible]T2X6[illegible]33	1[illegible]	NOT DISRUPTED	[illegible]	
0UUC9CCL	1G	NOT DISRUPTED	[illegible]	
J0[illegible]VF347	1F	NOT DISRUPTED	[illegible]	
0UUC9AAG	1G	DISRUPTED END TERMINAL	9999	NOT RESTORABLE
RE[illegible]V[illegible]ASV	1[illegible]	DISRUPTED	[illegible]23	REROUTED

Figure 4-4 Circuit Status Summary (sheet 1 of 5)

CIRCUIT STATUS

[illegible] PAGE 02 OF 26

CCSD	TSP	STATUS	REST.TIME(MIN)	ACTION
[illegible]	1	NOT DISRUPTED	[illegible]	
[illegible]C9CA	1[illegible]	NOT DISRUPTED	[illegible]	
[illegible]TAX[illegible]51	1	NOT DISRUPTED	[illegible]	
[illegible]T X[illegible]35	1C	NOT DISRUPTED	[illegible]	
[illegible]C[illegible]432	1[illegible]	NOT DISRUPTED	[illegible]	
[illegible]TAXBE59	1[illegible]	NOT DISRUPTED	[illegible]	
[illegible]UC[illegible]459	13	DISRUPTED END TERMINAL	9999	NOT RESTORABLE
REUV[illegible]Y7	1[illegible]	NOT DISRUPTED	[illegible]	
JH0A[illegible]F9A	1[illegible]	NOT DISRUPTED	[illegible]	
J[illegible]1A[illegible]F9A	1	NOT DISRUPTED	[illegible]	
DTXX[illegible]F41	1C	DISRUPTED	0216	REROUTED
JOEADH48	1E	NOT DISRUPTED	[illegible]	
DUUC9C[illegible]	1[illegible]	DISRUPTED END TERMINAL	9999	NOT RESTORABLE
JD[illegible]V9K19	1[illegible]	NOT DISRUPTED	[illegible]	
UKKB9DAS	1[illegible]	NOT DISRUPTED	[illegible]	
41KB9DAS	1[illegible]	NOT DISRUPTED	0002	
22KB9DAS	1[illegible]	NOT DISRUPTED	[illegible]	
03KB9DAS	1[illegible]	NOT DISRUPTED	[illegible]	
DUUC9AEJ	1G	NOT DISRUPTED	[illegible]	
DUUC9CXC	1G	NOT DISRUPTED	[illegible]	
CVD89DVL	1[illegible]	NOT DISRUPTED	0002	
JJBVA987	1[illegible]	NOT DISRUPTED	0002	
TGDVA82S	1D	NOT DISRUPTED	0002	
DUUC9CCF	1D	NOT DISRUPTED	0002	
DUUC9CK9	1D	NOT DISRUPTED	0002	
HCYM[illegible]DLK	19	NOT DISRUPTED	0009	
CVPV21FR	19	NOT DISRUPTED	0006	
HDSAB095	1C	NOT DISRUPTED	0002	
HCYM[illegible]AKU	1D	NOT DISRUPTED	0002	
DUUC0436	1G	NOT DISRUPTED	0002	
COJB2438	1C	DISRUPTED	9999	MULTIPT NON-RESTORABLE
01JB2438	1C	NOT DISRUPTED	0006	
02JB2438	1C	NOT DISRUPTED	0002	
03JB2438	1C	NOT DISRUPTED	0006	
DUUC9ACF	1C	DISRUPTED END TERMINAL	9999	NOT RESTORABLE
8UEE9G[illegible]5	1G	NOT DISRUPTED	0008	
8U1E9G[illegible]8	1G	NOT DISRUPTED	0002	
TGRV[illegible]D[illegible]X	1D	NOT DISRUPTED	0002	
DDDA[illegible]A8E	1A	NOT DISRUPTED	0000	
01DA[illegible]A8E	1A	NOT DISRUPTED	0006	
02DA[illegible]A8E	1A	NOT DISRUPTED	0000	
03DA[illegible]A8E	1A	NOT DISRUPTED	0002	
[illegible]4DA[illegible]A8E	1A	NOT DISRUPTED	0002	
[illegible]5DA[illegible]A8E	1A	NOT DISRUPTED	0000	
06DA[illegible]A8E	1A	NOT DISRUPTED	0002	
07DA[illegible]A8E	1A	NOT DISRUPTED	0000	
08DA[illegible]A8E	1A	NOT DISRUPTED	0006	
09DA[illegible]A8E	1A	NOT DISRUPTED	0002	
10DA[illegible]A8E	1A	NOT DISRUPTED	0004	

Figure 4-4, Circuit Status Summary (sheet 2 of 5)

CIRCUIT STATUS:

CIRCUITS: [illegible]

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CCSD	[illegible]	CONDITION		REST.TIME(MIN)	ACTION
11DAWA8E	1A	NOT DISRUPTED		0002	
12DAWA8E	1A	NOT DISRUPTED		[illegible]	
13DAWA8E	1[illegible]	NOT DISRUPTED		[illegible]	
14DAWA8E	1[illegible]	NOT DISRUPTED		[illegible]	
15DAWA8E	1[illegible]	NOT DISRUPTED		[illegible]	
0UUC9C[illegible]	1C	NOT DISRUPTED		[illegible]	
0TXX6G7E	1C	NOT DISRUPTED		[illegible]	
J0[illegible]0J56	1E	NOT DISRUPTED		[illegible]	
0TXX6[illegible]37	1C	NOT DISRUPTED		[illegible]	
RCY[illegible]376	1[illegible]	NOT DISRUPTED		[illegible]	
JUAE9[illegible]	1[illegible]	DISRUPTED		0031	REROUTED
0TXX6023	1E	NOT DISRUPTED		[illegible]	
JUAE9[illegible]C	1[illegible]	DISRUPTED		0031	REROUTED
0UUC[illegible]413	1G	DISRUPTED END	TERMINAL	9999	NOT RESTORABLE
0U0[illegible]	1C	NOT DISRUPTED		[illegible]	
0TYX6J52	1G	NOT DISRUPTED		[illegible]	
0TXX6091	1[illegible]	NOT DISRUPTED		[illegible]	
0TXX6F19	1C	NOT DISRUPTED		[illegible]	
0T1X6F19	1C	NOT DISRUPTED		[illegible]	
0UUC8476	1G	NOT DISRUPTED		0002	
0UUC9ACE	1G	DISRUPTED END	TERMINAL	9999	NOT RESTORABLE
0UUC9CKU	1G	NOT DISRUPTED		[illegible]	
0TXX6G1J	1C	NOT DISRUPTED		[illegible]	
UKKE9GKV	1D	NOT DISRUPTED		0000	
UK1E9GKV	1D	DISRUPTED		0066	REROUTED
JK2E9GKV	1D	NOT DISRUPTED		[illegible]	
0UUC8481	1G	NOT DISRUPTED		[illegible]	
RCY[illegible]F[illegible]6	1[illegible]	NOT DISRUPTED		[illegible]	
0UUC9CE[illegible]	1G	DISRUPTED END	TERMINAL	9999	NOT RESTORABLE
0TXX6D84	1C	NOT DISRUPTED		[illegible]	
5YAV[illegible]EFH	1G	DISRUPTED		[illegible]51	REROUTED
0TXX6E94	1C	DISRUPTED		0029	REROUTED
[illegible]CIL25J0	1C	DISRUPTED		9999	VFCT NOT RESTORED
JKKB9A[illegible]	1D	NOT DISRUPTED		[illegible]	
JCAV9S[illegible]9	1E	NOT DISRUPTED		[illegible]	
UKKB9B[illegible]	1D	NOT DISRUPTED		[illegible]	
CVGR21[illegible]	1[illegible]	NOT DISRUPTED		[illegible]	
0UUC9CC[illegible]	1G	NOT DISRUPTED		[illegible]	
0UUC9CFR	1G	DISRUPTED END	TERMINAL	9999	NOT RESTORABLE
0UUC8428	1G	NOT DISRUPTED		[illegible]	
RUEE9[illegible]	1G	NOT DISRUPTED		[illegible]	
RU1E9[illegible]	1G	NOT DISRUPTED		[illegible]	
JUEE9G[illegible]	1G	DISRUPTED		[illegible]12	REROUTED
0TXX6G7	1E	NOT DISRUPTED		[illegible]	
[illegible]KLV[illegible]AY[illegible]	1[illegible]	NOT DISRUPTED		[illegible]	
RCY[illegible]AK[illegible]	1[illegible]	NOT DISRUPTED		[illegible]	
0DCB9BAX	1A	NOT DISRUPTED		[illegible]	
0TXX6H45	1C	NOT DISRUPTED		[illegible]	
JCAV[illegible]FXZ	1C	NOT DISRUPTED		[illegible]	

Figure 4-4. Circuit Status Summary (sheet 3 of 5)

CCSD		CONDITION	REST.TIME(MIN)	ACTION
[illegible]CY[illegible]X92	1[illegible]	NOT DISRUPTED	[illegible]	
[illegible]KK[illegible]9C[illegible]	1[illegible]	NOT DISRUPTED	[illegible]	
HOSA[illegible]21[illegible]	1[illegible]	NOT DISRUPTED	[illegible]	
[illegible]ON[illegible]1R26	1C	DISRUPTED	[illegible]012	REROUTED
DUUC9C[illegible]A	1[illegible]	DISRUPTED	[illegible]255	REROUTED
DDDA[illegible]A[illegible]	1[illegible]	NOT DISRUPTED	[illegible]	
[illegible]1DA[illegible]A[illegible]	1[illegible]	NOT DISRUPTED	[illegible]	
[illegible]2DA[illegible]A[illegible]	1A	NOT DISRUPTED	[illegible]	
[illegible]3DA[illegible]A[illegible]	1A	NOT DISRUPTED	[illegible]	
[illegible]D[illegible]L123E	1C	DISRUPTED	[illegible]077	REROUTED
[illegible]1L123F	1C	DISRUPTED	9999	NO ACTION ON PRE-PLANNED
RCY[illegible]CLE	1[illegible]	NOT DISRUPTED	0000	
JD[illegible]E9G[illegible]S	1[illegible]	DISRUPTED	0012	REROUTED
HOSA8[illegible]99	1[illegible]	DISRUPTED	9999	VFCT NOT RESTORED
JDEA[illegible]GYG	1[illegible]	NOT DISRUPTED	[illegible]	
DTXX6G1G	1C	NOT DISRUPTED	[illegible]	
DUUC9CJG	1G	DISRUPTED	0457	REROUTED
DTQX6F1[illegible]	1C	NOT DISRUPTED	[illegible]	
DUUC8463	1G	DISRUPTED END TERMINAL	9999	NOT RESTORABLE
DTXX6D[illegible]2	1C	DISRUPTED	[illegible]127	REROUTED
DTXX6H[illegible]7	1A	NOT DISRUPTED	[illegible]	
JD[illegible]VOR15	1[illegible]	NOT DISRUPTED	0000	
DODA9GPA	1A	NOT DISRUPTED	[illegible]	
DTGX6D[illegible]8	1A	NOT DISRUPTED	[illegible]	
DTXX6E21	1[illegible]	NOT DISRUPTED	[illegible]	
DT1X6E21	1[illegible]	NOT DISRUPTED	[illegible]	
JHDA[illegible]F98	1D	NOT DISRUPTED	[illegible]	
JH1A[illegible]F98	1D	NOT DISRUPTED	[illegible]	
DUBH22CE	1C	NOT DISRUPTED	[illegible]	
DTXX6G[illegible]	1E	NOT DISRUPTED	[illegible]	
DUUC9AA[illegible]	1G	DISRUPTED END TERMINAL	9999	NOT RESTORABLE
DUUC9ACA	1G	DISRUPTED END TERMINAL	9999	NOT RESTORABLE
DTXX6F79	1D	NOT DISRUPTED	[illegible]	
UKKB9B[illegible]V	1D	NOT DISRUPTED	0000	
BOCA[illegible]E20	1F	NOT DISRUPTED	[illegible]	
RCYM[illegible]AKS	1D	NOT DISRUPTED	[illegible]	
DUUC9CFG	1D	DISRUPTED END TERMINAL	9999	NOT RESTORABLE
DUUC9CH[illegible]	1G	NOT DISRUPTED	0000	
DUUC9CG[illegible]	1G	NOT DISRUPTED	[illegible]	
DUUC9CHC	1C	DISRUPTED	0216	REROUTED
JPGAC471	1C	NOT DISRUPTED	[illegible]	
DUUC9ACR	1G	DISRUPTED END TERMINAL	9999	NOT RESTORABLE
TO[illegible]V[illegible]E4H	1D	NOT DISRUPTED	[illegible]	
UKKB9B[illegible]J	1D	NOT DISRUPTED	[illegible]	
UKKE9HED	1D	NOT DISRUPTED	[illegible]	
UK1E9HED	1D	NOT DISRUPTED	[illegible]	
UK2E9HED	1D	NOT DISRUPTED	0000	
RCYMDS[illegible]	1D	NOT DISRUPTED	0000	
UZHN9E[illegible]	1D	DISRUPTED END TERMINAL	9999	NOT RESTORABLE

Figure 4-4. Circuit Status Summary (sheet 4 of 5)

CIRCUIT STATUS:

CIRCUITS: [illegible] PAGE 025 OF 026

CCSD	PR	STATUS	REST.TIME(MIN)	ACTION
0ULF9GAM	10	NOT DISRUPTED	0000	
0U1F9GAM	10	NOT DISRUPTED	0000	
ND0M1E43	1C	RESTORED	0000	PREPLANNED ALT-RTE
ND1M1E43	1C	PREEMPTED	9999	
UKLY9SF.	10	NOT DISRUPTED	0000	
0UUC9CLM	1G	NOT DISRUPTED	0000	
KCYV0G31	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
01YV0G31	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
02YV0G31	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
03YV0G31	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
JUDMDARY	1C	NOT DISRUPTED	0000	
DUUC9ACJ	1G	DISRUPTED END TERMINAL	9999	NOT RESTORABLE
9B0MF052	10	NOT DISRUPTED	0000	
CAPV2319	1C	NOT DISRUPTED	0000	
DTXX6F71	1C	NOT DISRUPTED	0000	
RCYMNCLM	10	NOT DISRUPTED	0000	
DTXX6D27	1C	NOT DISRUPTED	0000	
RCYMNCRA	10	NOT DISRUPTED	0000	
DTXX6E26	1C	NOT DISRUPTED	0000	
JUEE9GAM	1G	NOT DISRUPTED	0000	
DTPX6F14	10	NOT DISRUPTED	0000	
0UUC9CVG	1G	NOT DISRUPTED	0000	
RCYRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
01YRM432	10	NOT DISRUPTED	0000	
02YRM432	10	NOT DISRUPTED	0000	
03YRM432	10	NOT DISRUPTED	0000	
04YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
05YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
06YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
07YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
08YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
09YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
10YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
11YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
12YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
13YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
14YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
15YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
16YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
17YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
18YRM432	10	NOT DISRUPTED	0000	
19YRM432	10	NOT DISRUPTED	0000	
20YRM432	10	NOT DISRUPTED	0000	
21YRM432	10	NOT DISRUPTED	0000	
22YRM432	10	NOT DISRUPTED	0000	
23YRM432	10	NOT DISRUPTED	0000	
24YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
25YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE
26YRM432	10	DISRUPTED	9999	MULTIPT NON-RESTORABLE

Figure 4-4. Circuit Status Summary (sheet 5 of 5)

With minor modification, the CRAM can also provide reports which show the actual routing of rerouted circuits.

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ATTN: Library

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Department of the Army
ATTN: AETVGB
ATTN: AETVCE
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VII Corps
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ATTN: AETSGB-O
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Department of the Navy
ATTN: OP 941

Naval Ocean Systems Center
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Naval Surface Weapons Center
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Office of the Chief of Naval Operations
ATTN: OP 96
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Commander-in-Chief
U.S. Atlantic Fleet
ATTN: Code J54
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Commander-in-Chief
U.S. Naval Forces, Europe
ATTN: N3262 Nuclear Surety Officer

DEPARTMENT OF THE AIR FORCE

Air Force Geophysics Laboratory
ATTN: SULL

DEPARTMENT OF THE AIR FORCE (Continued)

Air Force Weapons Laboratory
Air Force Systems Command
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Intelligence
Department of the Air Force
ATTN: INAK

Assistant Chief of Staff
Studies & Analyses
Department of the Air Force
ATTN: AF/SAGF
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Deputy Chief of Staff
Operations Plans and Readiness
Department of the Air Force
ATTN: AFXOXFM
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ATTN: AFRDQSM

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Headquarters Space Division
Air Force Systems Command
ATTN: SKA

Headquarters Space Division
Air Force Systems Command
ATTN: YCPC

Strategic Air Command
Department of the Air Force
ATTN: DCXT
ATTN: NRT
ATTN: XPFS

Tactical Air Command
Department of the Air Force
ATTN: DRA

Commander-in-Chief
U.S. Air Forces in Europe
ATTN: XPXX
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OTHER GOVERNMENT AGENCY

Central Intelligence Agency
ATTN: OSR/SF, R. Virgo
ATTN: OSR/SEC
ATTN: OSI/LSD, R. Hart

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66th MI Group
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ATTN: Library

ESL, Inc.
ATTN: J. Marshall
ATTN: Library

General Electric Company—TEMPO
ATTN: DASIAC

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GTE Sylvania, Inc.
ATTN: M. Cross

Institute for Defense Analyses
ATTN: D. Signori
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Kaman Sciences Corp.
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ATTN: R. Schaefer
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R & D Associates
ATTN: A. Cicolani
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RCA Corp.
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TRW Defense & Space Sys. Group
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BDM Corp.
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